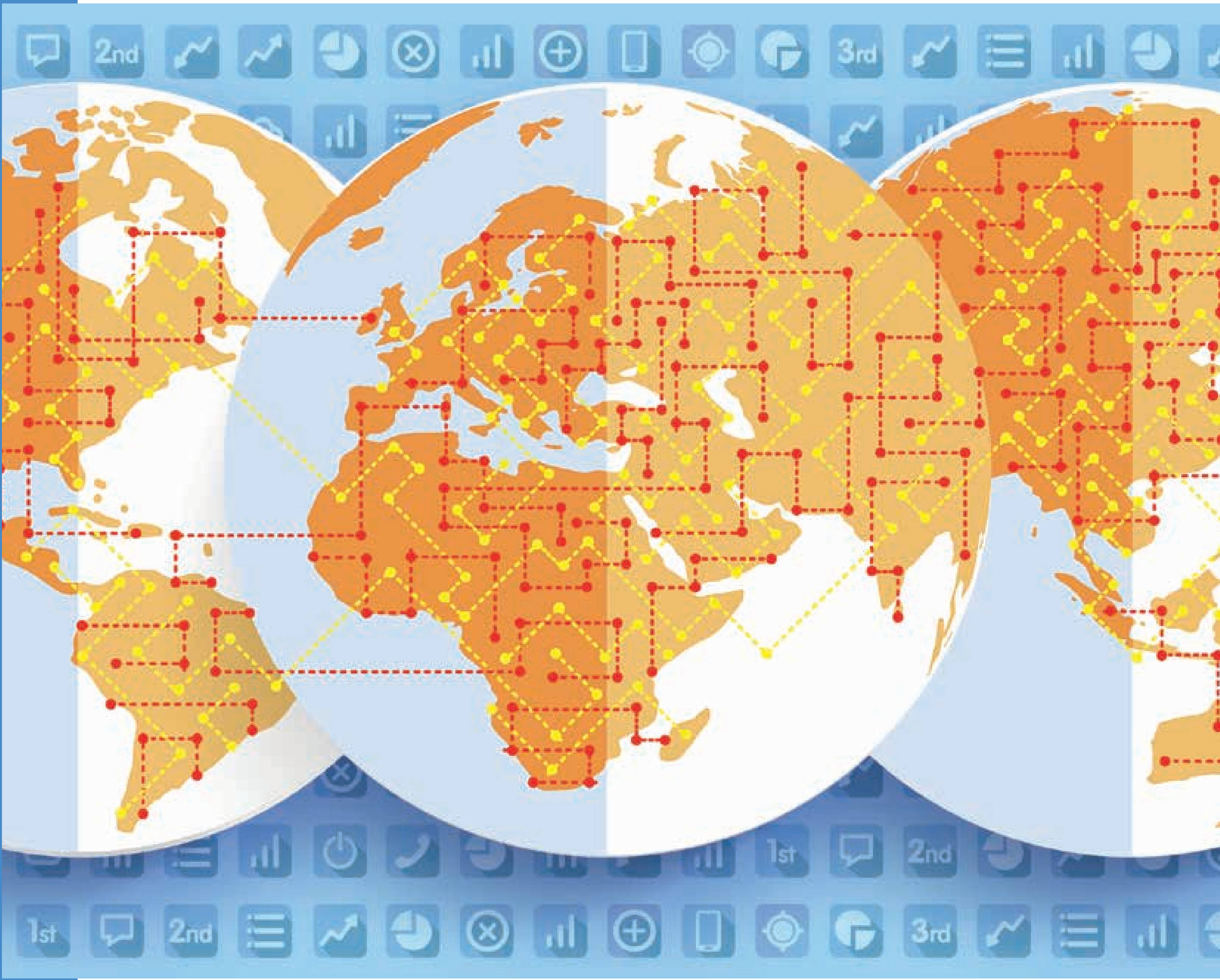

Measuring the Information Society Report

2014

Measuring the Information Society Report 2014

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Foreword

I am pleased to present to you the 2014 edition of the *Measuring the Information Society Report*. Now in its sixth year, this annual report identifies key information and communication technology (ICT) developments and tracks the cost and affordability of ICT services, in accordance with internationally agreed methodologies. Its core feature is the *ICT Development Index* (IDI), which ranks countries' performance with regard to ICT infrastructure, use and skills. The report aims to provide an objective international performance evaluation based on quantitative indicators and benchmarks, as an essential input to the ICT policy debate in ITU Member States.

Over the past year, the world witnessed continued growth in the uptake of ICT and, by end 2014, almost 3 billion people will be using the Internet, up from 2.7 billion at end 2013. While the growth in mobile-cellular subscriptions is slowing as the market reaches saturation levels, mobile broadband remains the fastest growing market segment, with continuous double-digit growth rates in 2014 and an estimated global penetration rate of 32 per cent – four times the penetration rate recorded just five years earlier. International bandwidth has also grown steeply, at 45 per cent annually between 2001 and 2013, and the developing countries' share of total international bandwidth increased from around 9 per cent in 2004 to almost 30 per cent in 2013. Overall, almost all of the 166 countries included in the IDI improved their values in the last year.

Despite this encouraging progress, there are important digital divides that need to be addressed: 4.3 billion people are still not online, and 90 per cent of them live in the developing world. Fixed-broadband penetration stands at 6 per cent in developing countries, compared with 27.5 per cent in developed countries, and growth rates are slowing. Mobile broadband is growing fast, but the difference between developed and developing regions remains large, with 84 per cent penetration in the former as against 21 per cent in the latter. Increasing ICT uptake in the world's least connected countries (LCCs), which are home to some 2.5 billion people, should therefore be the policy focus for the years to come. In these countries, the share of population living in rural areas is often high, reinforcing the urban-rural digital divide. As this report finds, ICT performance is better in countries with higher shares of the population living in urban areas, where access to ICT infrastructure, usage and skills is more favourable. Yet it is precisely in poor and rural areas where ICTs can make a particularly significant impact. New analysis featured in this report shows that many of the indicators of the Millennium Development Goals (MDGs) show significant correlation with the IDI, notably those related to poverty reduction and health improvement. Furthermore, the report finds that progress in ICT development is linked to progress in achieving some of the MDGs, yet another testimony to the role of ICT as a development enabler.

One reason for the limited uptake of ICT in the developing world is the price of the service, which is often unaffordable for poor segments of the population. While the prices of fixed and mobile services continue to decrease globally, in most developing countries the cost of a fixed-broadband plan represents more than 5 per cent of GNI per capita, and mobile broadband is six times more affordable in developed countries than in developing countries. Income inequalities within countries are one of the reasons why broadband – in particular fixed broadband – remains unaffordable to large segments of the population. The report finds that in 40 per cent of countries a basic fixed-broadband subscription still represents more than 5 per cent of household income for over half of the population. For these income groups, mobile broadband may be the affordable alternative.

An enabling telecommunication regulatory environment can significantly influence the affordability of services. The report finds that the price of ICT services falls with better market regulation and increased competition. For example, in developing countries, fixed-broadband prices could be reduced by 10 per cent and mobile-cellular prices by 5 per cent if competition and/or the regulatory framework improved. International regulatory best practices, such as the ones adopted by the ITU Global Symposium for Regulators (GSR), may serve as a guideline for effective regulatory frameworks which can lay the foundations for affordable fixed-broadband services.

In this fast-changing digital era, one of the key challenges in measuring the information society is the lack of up-to-date data, in particular in developing countries. ITU is joining the international statistical community in looking into ways of using new and emerging data sources – such as those associated with big data – to better provide timely and relevant evidence for policy-making. Calls for a "data revolution" are prominent in the international debates around the post-2015 development agenda, and ICTs have an important role to play in view of their capacity to produce, store and analyse huge amounts of data, as well as being a major source of big data in their own right. Big data from mobile operators, for example, are real-time and low-cost and have one of the greatest development potentials in view of the widespread use and availability of mobile networks and services. This report provides the reader with a comprehensive and critical overview of the role of big data from the telecommunication sector, for use in social and economic development policy and for monitoring the future information society.

I trust that the data and analysis contained in this report will be of great value to the ITU membership, including policy-makers, the ICT industry and others working towards building an inclusive global information society.

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Chapter 1. Recent information society developments

1.1 Introduction

The past year has been characterized by uninterrupted growth in the spread of information and communication technology (ICT) infrastructure and in ICT uptake by citizens and public and private organizations. While the global mobile-cellular market is approaching saturation levels, mobile-broadband uptake continues to grow at double-digit rates in all regions, and mobile broadband remains the strongest growing market segment. This trend is accompanied by a slowdown in fixed-broadband uptake in the developing world, where mobile-broadband services provide a response to the demand for high-speed Internet access in view of the lack of affordable fixed-broadband services, whereas in the developed world both fixed- and mobile-broadband uptake is growing continuously.

The data also show a continuous increase in Internet usage, with growth in the number of Internet users in all countries and increasing availability of online content, much of which is user-created through social media applications and platforms (e.g. Twitter, YouTube, WhatsApp). With more and more applications now available through mobile platforms (mobile apps), and the strong growth in mobile Internet uptake, an increasing number of people are joining, and participating actively in, the information society.

While the information society is growing worldwide, digital divides remain – and are even widening – in some segments. In particular, there is a significant and persistent urban-rural digital divide, whereby urban citizens enjoy ubiquitous mobile network coverage, affordable high-speed Internet services and the higher levels of skills required to make effective use of online content and services, while the opposite is often the case in rural and remote areas of many developing countries.

This chapter will present and discuss key indicators for monitoring the global information society. It will first look at the uptake of ICT infrastructure and services, covering the fixed and mobile (voice and data) market segments, and considering both subscriptions and household access data. This will be followed by a presentation of the latest trends in terms of investment and revenue in the telecom sector. Then, a number of key indicators will be presented concerning ICT uptake by individuals, businesses and public organizations (from the government and education sectors), as well as growth in online content and particularly social media. The final part of the chapter will discuss emerging issues related to information-society measurements, in particular in the context of the post-2015 development debate and the WSIS+10 review, the demand for a data revolution, and the role of big data for ICT monitoring.

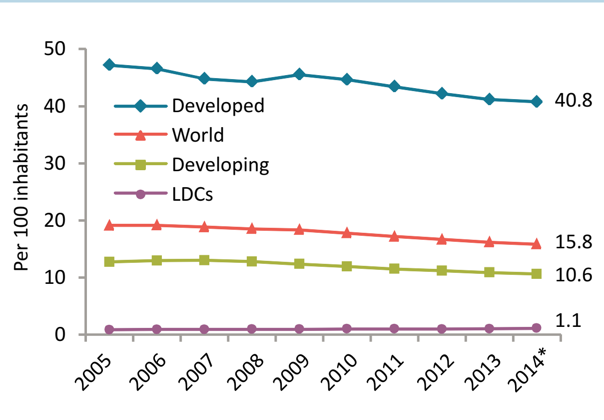
1.2 The voice market

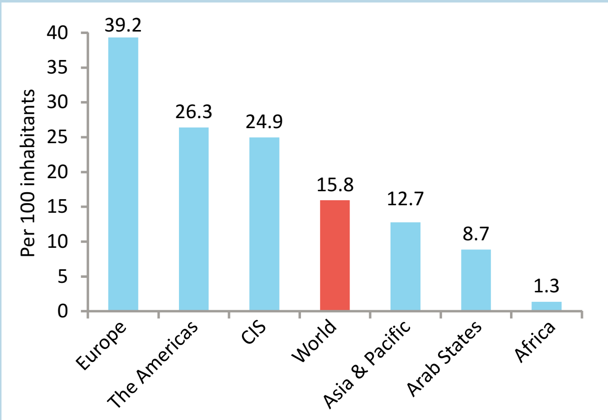
In line with developments in recent years, fixed telephony is on the decline in all regions of the world (Chart 1.1). Worldwide, there are only around a dozen countries where fixed-telephone uptake has actually increased over the past year.[1] Fixed-telephone penetration decreased by about 2 per cent globally in the past year, and will drop to its lowest level in 14 years – lower than at the turn of the century – with an estimated 1.1 billion subscriptions by end 2014. The decrease is stronger in developed countries (2.4 per cent) than developing countries (1 per cent), and strongest in the Americas region (2.6 per cent), followed by Asia and the Pacific (2 per cent).

The decline in fixed-telephone subscriptions over the past decade was accompanied by strong growth in the mobile-cellular market until 2010, at which point mobile-cellular growth rates dropped to single digits, and they have continued to slow down since then. In 2014, global growth in mobile penetration will be at a ten-year low of 2.6 per cent, as the market reaches saturation levels, in particular in developed countries where penetration will reach 121 per cent (Chart 1.2). By end 2014, there will be almost as many mobile-cellular subscriptions (6.9 billion) as people on Earth, more than three quarters of them (5.4 billion) in the developing world and more than half (3.6 billion) in the Asia-Pacific region. While this does not mean that everyone has a mobile phone – since many people have more than one subscription or SIM card – the total numbers and growth rates strongly point to market saturation. Whether this will change in the near future, and whether growth will pick up again, will depend among other things on the types of service plans that will be offered in national markets and their uptake by individuals.

Looking at the six world regions, Africa and Asia and the Pacific are the regions with the strongest mobile-cellular growth, and the lowest penetration rates, which will reach 69 per cent and 89 per cent, respectively, by end 2014.

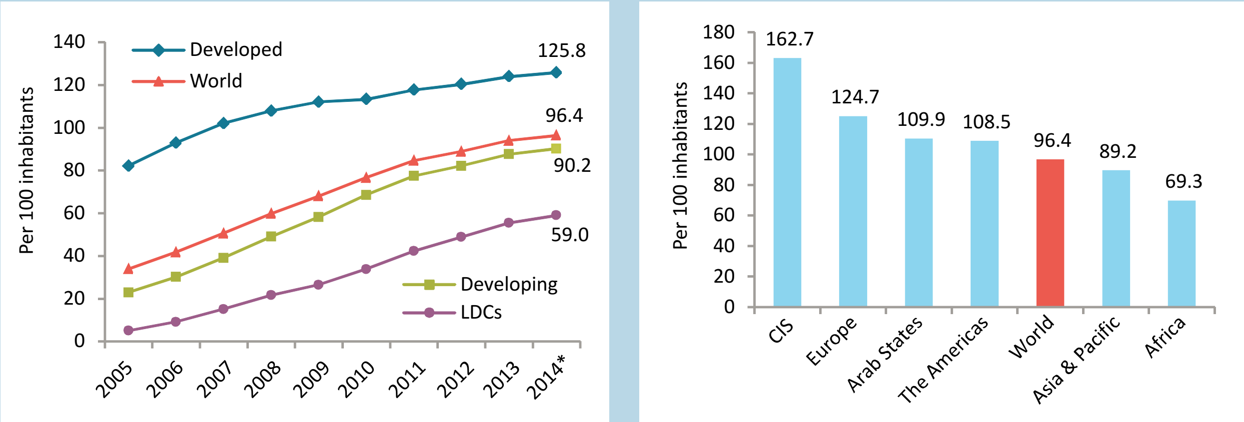
Chart 1.1: Fixed-telephone subscriptions by level of development, 2005-2014 (left) and by region, 2014* (right)





Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

Chart 1.2: Mobile-cellular subscriptions by level of development, 2005-2014 (left) and by region, 2014* (right)



Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

Penetration rates in the CIS countries, Arab States, Americas and Europe have attained levels above 100 per cent since 2012 and are expected to grow at less than 2 per cent in 2014.

The above numbers suggest that, globally speaking, the voice market is reaching saturation: the fixed-telephone market is shrinking and the mobile-cellular market is tapering off. In addition, mobile-cellular population coverage has reached 93 per cent globally: in other words, almost every person on the globe lives within reach of a mobile-cellular signal and, at least theoretically, has access to mobile communication services.

Closer examination and disaggregation of the data reveal, however, that digital divides still exist and that some people are still excluded from access to communication networks.

First, there are populations living in rural areas that are not covered by a mobile-cellular signal (Table 1.1). Even though rural population coverage is very high, at 87 per cent globally, at end 2012 around 450 million people worldwide still lived out of reach of a mobile signal.

Second, high mobile-cellular penetration does not imply that everyone owns or is using a mobile phone. For countries where data are available, the number of mobile subscriptions far exceeds the number of mobile phone users (Partnership, 2014). No regular pattern can be established, though, and the difference between mobile-phone user penetration and mobile-cellular subscription penetration ranges between 8 per cent (France) and 111 per cent (Panama) across countries. According to GSMA estimates, unique mobile subscribers account for about half of mobile-cellular subscriptions, which would translate into a penetration rate of around 48 per cent globally, 63 per cent in developed countries, 45 per cent in developing countries and 30 per cent in least developed countries (LDCs).[2]

Third, household access to a telephone is still not the norm in many developing countries, in particular in LDCs (Partnership, 2014). For example, according to the latest population and housing census carried out in India in 2011, 63 per cent of households had a telephone (up from 9 per cent ten years earlier). In addition, there were significant differences between urban and rural areas, with 82 per cent of Indian urban households having access to a telephone compared with 54 per cent of rural households.[3] Household telephone penetration in Malawi stood at 36 per cent in 2011 – 73 per cent in urban households

Table 1.1: Rural population covered by a mobile-cellular signal, 2012

	Overall mobile-cellular population coverage (%)	Rural population covered (%)	Rural population covered (millions)	Rural population not covered (millions)
Africa	88	79	498	129
Americas	99	96	171	9
Asia	92	87	2 017	309
Europe	99	98	196	3
Oceania	96	81	0.9	0.2
World	**93**	**87**	**2’883**	**450**

Source: Partnership (2014) based on ITU data.

and 29 per cent rural households. In Uganda, the numbers were 46 per cent (total), 81 per cent (urban) and 38 per cent (rural).The urban-rural gap in household telephone access prevails in many developing countries for which data are available, but is closing with the availability of affordable mobile-phone services in rural areas.

Further research and data would be necessary to determine people’s access to, and use of, voice communications and to identify other potential barriers, such as those related to poverty, literacy, education or lack of electricity, as well as cultural and social barriers.

1.3 The broadband market and Internet access

Fixed (wired)-broadband and mobile-broadband markets

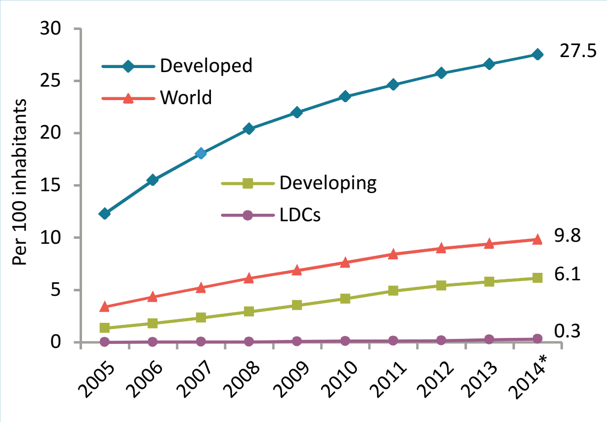
Infrastructure deployment providing access to broadband Internet continues to be a priority for telecommunication service providers and governments in most countries. This is reflected in the continuous growth in the number of mobile- and fixed-broadband subscriptions worldwide.

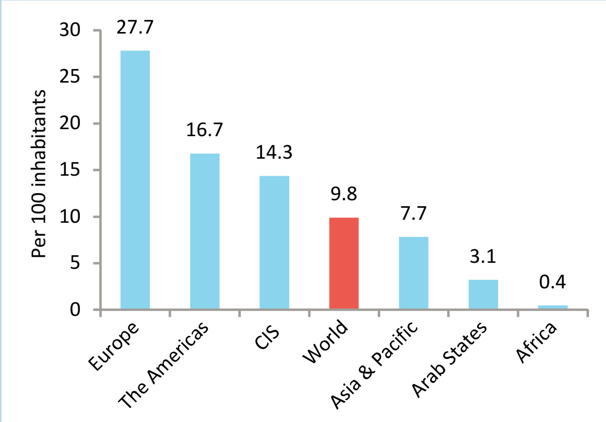
In 2014, fixed-broadband subscriptions will reach a total of 711 million globally, corresponding to a penetration rate of almost 10 per cent (Chart 1.3), as against 220 million and 3.4 per cent in 2005. Distinct patterns can be observed, though, between developed and developing regions. In most developed countries, fixed-broadband penetration has already reached relatively mature levels, with a penetration of 27.5 per cent and continuous low growth, at around 3.5 per cent in 2014.

In developing countries, fixed-broadband penetration growth rates have dropped from 18 per cent in 2011 to 6 per cent in 2014, reaching an overall (low) penetration rate of 6 per cent by end 2014, and less than 1 per cent in LDCs. In the latter, fixed-broad band infrastructure and uptake has not (yet) materialized. This slowdown in/low growth of fixed-broadband subscriptions, despite low penetration, coincides with a strong growth in mobile-broadband subscriptions in the developing world (see Chart 1.3).

A closer look at different regions shows that Africa, the Arab States and CIS are the regions with double-digit fixed-broadband penetration growth rates, whereas the Americas region displays the lowest growth in fixed broadband, estimated at 2.5 per cent and reaching a penetration rate of around 17 per cent by end 2014. Asia and the Pacific stands out as a region registering relatively low fixed-broadband penetration (7.7 per cent) and a sharp decline in the growth of fixed broadband over the past four years. This has been mostly due to a

Chart 1.3: Fixed (wired)-broadband subscriptions by level of development, 2005-2014 (left) and by region, 2014* (right)





Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

slowdown in fixed-broadband growth in some of the larger economies, such as China, India, the Islamic Republic of Iran and Malaysia. Europe's fixed-broadband penetration is much higher compared with other regions and almost three times as high as the global average: 27.7 per cent and 9.8 per cent, respectively. For example, Switzerland is the country with the highest fixed-broadband penetration worldwide, at 40 per cent in 2014.

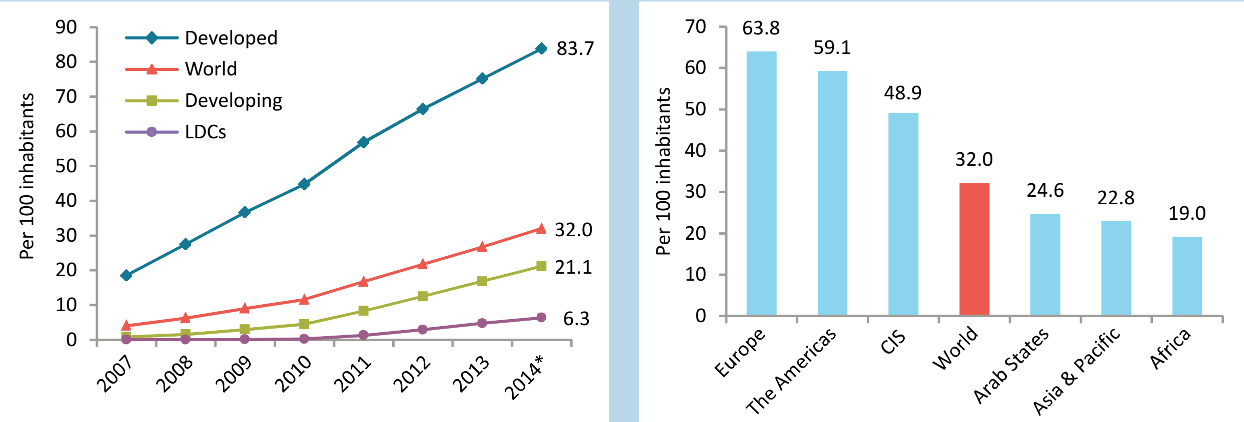
The Arab States region stands out with a low fixed-broadband penetration of 3.1 per cent by end 2014, the second lowest among all regions and considerably below the global average of almost 10 per cent. As compared with other key ICT indicators, the region performs lower than expected on this indicator. However, fixed-wireless broadband, which is not included in this figure, is prominent in some of the countries of the region. In Comoros, Somalia and Yemen, for example, no mobile-broadband services are available, but fixed-wireless and satellite services are offered. In Saudi Arabia, 30 per cent of all wireless-broadband subscriptions are fixed-wireless and satellite subscriptions.

Mobile broadband remains the fastest growing market segment, with continuous double-digit growth rates in 2014 and an estimated global penetration of 32 per cent – four times the penetration rate recorded just five years earlier (Chart 1.4). Mobile broadband is growing fastest in developing countries, where growth rates over the last year are expected to be twice as high as in developed countries (26 per cent, as against 11.5 per cent). This is driven by the availability and uptake of more affordable devices (smartphones) and types of plan on offer in the market.

Nevertheless, the divide between developed and developing countries remains huge: mobile-broadband penetration will reach 84 per cent in the former compared with 21 per cent in the latter. The high penetration in developed countries is partly due to very high uptake in populous countries such as the United States and Japan, where penetration rates reached 93 per cent and 120 per cent, respectively, at end 2013.

All regions continue to show double-digit growth rates, but Africa stands out with a growth rate of over 40 per cent – twice as high as the global average. By end 2014, mobile-broadband penetration in Africa will have climbed to almost 20 per cent, up from less than 2 per cent four

Chart 1.4: Active mobile-broadband subscriptions by level of development, 2007-2014 (left) and by region, 2014* (right)



Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

years earlier (Chart 1.4). This is partly explained by strong growth in populous countries such as Nigeria and South Africa, where mobile-broadband penetration reached 37 per cent and 29 per cent, respectively, by end 2013.

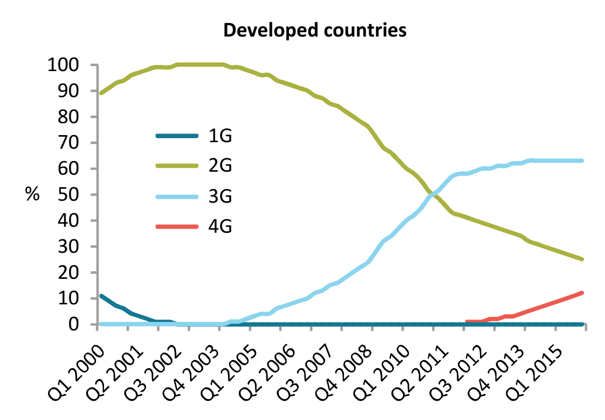
A closer look at the different mobile technologies and their market shares highlights the shift from lower-speed to higher-speed technologies over the past 15 years (Chart 1.5). In developed countries, 3G subscriptions overtook 2G subscriptions in 2010 and 3G growth is flattening. In developing countries, the large majority of subscriptions are still 2G, but 3G is growing rapidly and will overtake 2G subscriptions in a few years. 4G[4] services came onto the market only recently and 4G subscriptions still account for only a small market share, in both developed and developing countries.

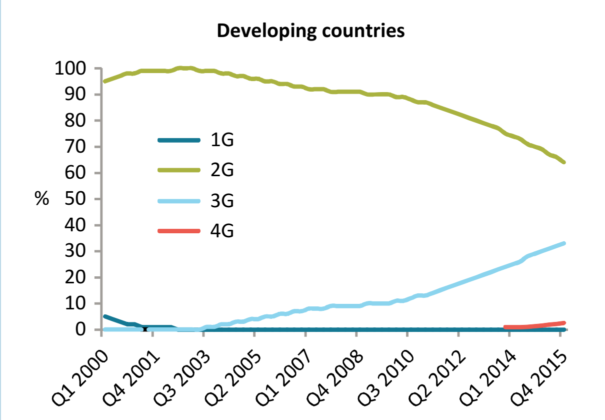
The data on fixed- and mobile-broadband uptake confirm what has been observed on the ground. In developed countries, fixed-broadband infrastructure and services were available much earlier than in most developing countries, and before fast mobile-broadband services and smartphones entered the market. This has contributed to the higher uptake of fixed broadband in developed countries. In developing countries, by contrast, on account of the limited fixed-broadband infrastructure and the lack of affordable fixed-broadband service offerings, mobile-broadband services are increasingly becoming an alternative to fixed broadband, and indeed the preferred choice of consumers. Furthermore, the mobile market has benefited from a more liberal regulatory approach than the fixed market, further contributing to its successful growth (ITU, 2014).

It should be noted that the numbers of fixed- and mobile-broadband subscriptions are, strictly speaking, not comparable. Fixed-broadband connections are mostly shared connections and deployed to a (physical) building (belonging to, for example, households, cybercafés, businesses or other public and private organizations). Mobile-broadband subscriptions are not bound by physical connections and usually refer to individuals, and – in the same way as with mobile-cellular subscriptions – there is a certain amount of double counting involved, for example when people use multiple devices (e.g. smartphone, tablet) and SIM cards.

Looking towards the future, the growth potential for mobile broadband looks promising, as

Chart 1.5: Share of mobile subscriptions by technology, 2000-2015, developed countries (left) and developing countries (right)





Source: ITU (2012); data based on ITU and Telecom Advisory Services calculations.

more and more countries upgrade their mobile networks. As mentioned earlier, 2G population coverage stands at over 90 per cent worldwide. Data on 3G population coverage are less available. According to ITU estimates, global 3G population coverage stood at around 50 per cent by end 2012, and there were still sizeable rural-urban gaps. Rural population coverage ranged from 100 per cent in the Gulf countries of United Arab Emirates and Bahrain to zero in some African countries (Chart 1.6).

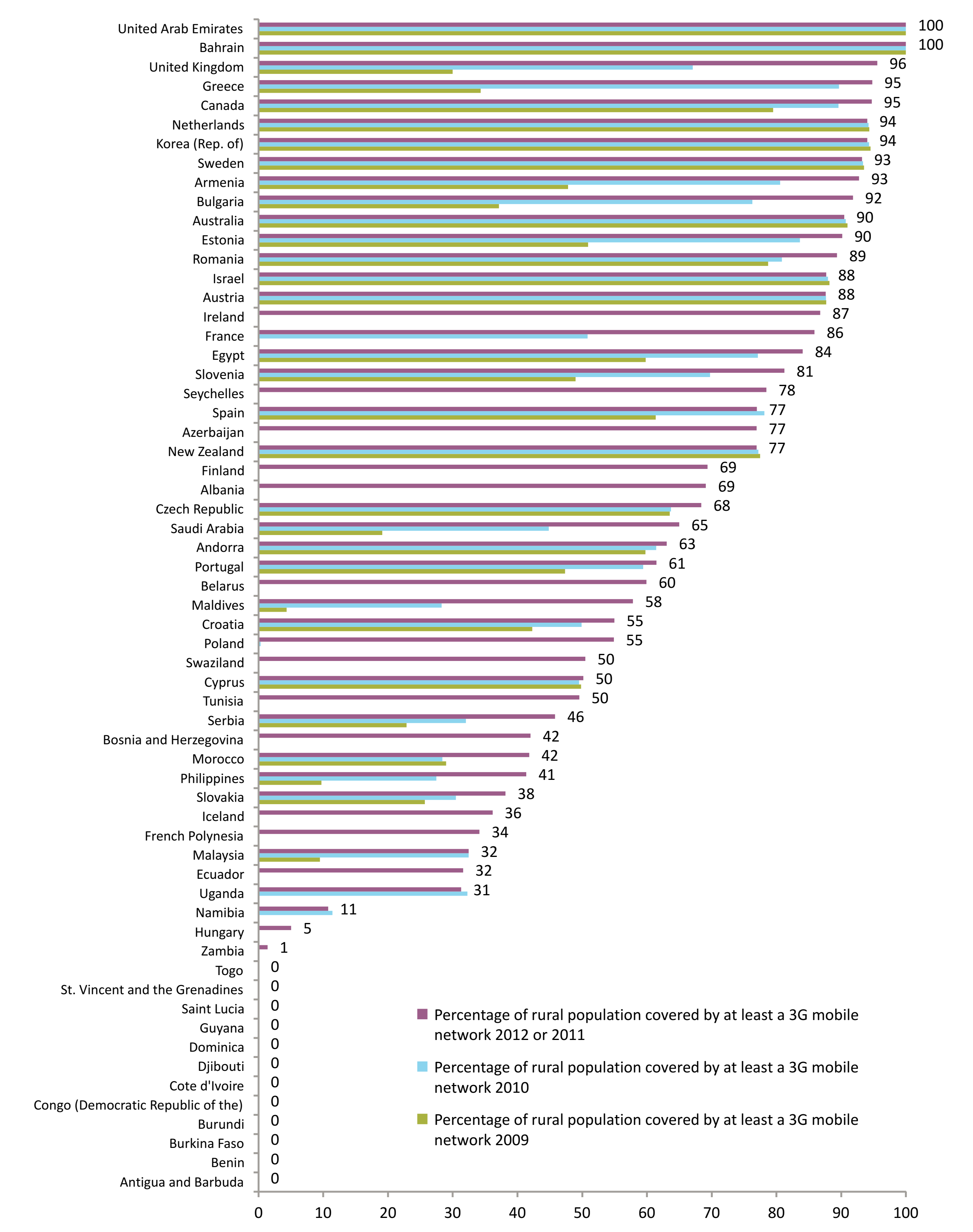
These numbers are, however, expected to change significantly in the near future, as more and more countries are deploying 3G+ technologies and services, and given the strong growth in mobile-broadband subscriptions. At the same time, the issue of spectrum allocation will have to be addressed to ensure that the increasing demand for high-speed mobile access can be met, including in rural areas, where the additional spectrum represented by the digital dividend could play a crucial role in universalizing mobile-broadband access.

Backbone and bandwidth

The growth in broadband subscriptions is accompanied by continuous growth in national backbone capacities and international Internet bandwidth. Indeed, without further deployment of backbone infrastructure, service providers are unable to expand their markets to previously underserved regions.

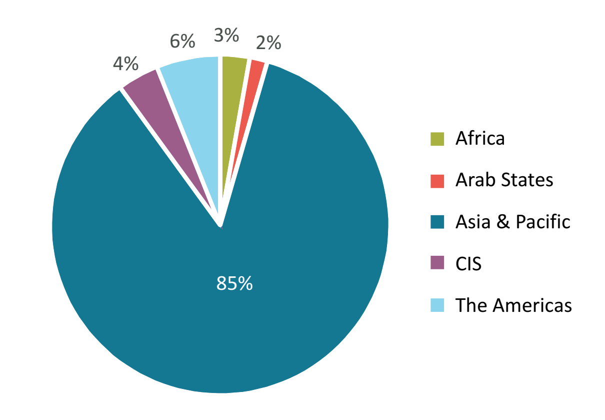
New data collected by ITU on the deployment of fibre transmission capacity in countries shows that by end 2013, more than 11.7 million km of fibre and microwave backbone transmission networks were available in the five regions covered so far: Africa, the Arab States, Asia and the Pacific, CIS countries, and Latin America and the Caribbean.[5] While these numbers reflect the huge efforts that have been made to increase international backbone capacity, a closer look at the data also reveals major disparities across regions: Asia and the Pacific (in particular China and India) accounts for more than 85 per cent of the total length of backbone networks (Chart 1.7, left). While this reflects the huge geographical size of the region, and the two countries in particular, the figures for available route metres per capita are also higher than in other regions. In Asia and the Pacific, there are 6.5 times as many route metres per capita than in Africa (Chart 1.7, right). On the other hand, not everyone lives within close range of the transmission networks. In Asia and the Pacific, 40 per cent of the population live out of reach

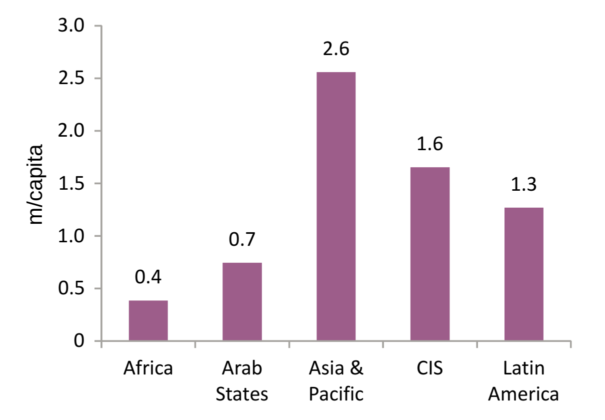
Chart 1.6: Rural population covered by at least a 3G mobile network, 2009-2012



Source: Partnership (2014) based on ITU data.

Chart 1.7: Fibre and microwave routes, share of route kilometres (left) and route metres per capita (right), selected regions, 2013





Source: ITU Trends in Telecommunication Reform, 2014.

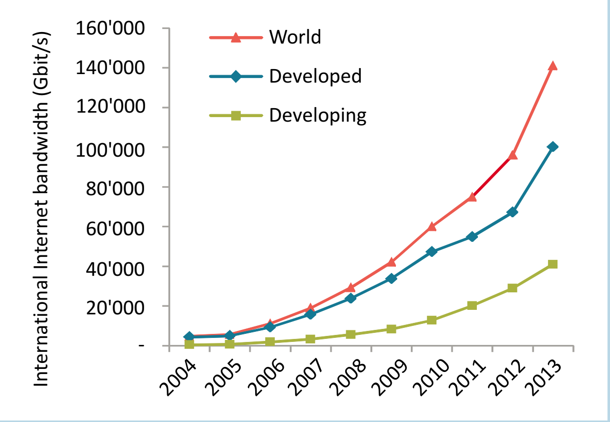
of an operational fibre transmission network (i.e. more than 50 km away), and just over 10 per cent live within a range of 10 km. In Africa, 30 per cent of the population live out of reach, and about 22 per cent live within a range of 10 km. These numbers reveal significant digital divides between and within regions and point to opportunities for service providers to increase their subscriber base (ITU, 2014).

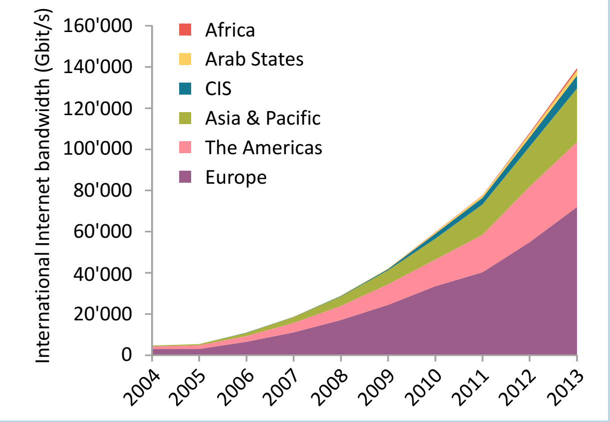
Another key indicator that provides further insight into the quality and speed of networks is the amount of international Internet bandwidth available in countries and regions, such bandwidth being a key requirement for delivering data-intensive applications and services through high-speed networks. While fibre transmission networks constitute an essential infrastructure that has to be available in order to provide access to high-speed networks, information on bandwidth is also required to gauge the actual quality and speed available.

Over the past decade, international Internet bandwidth has climbed sharply, from around 1 600 Gbit/s in 2001 to 60 400 Gbit/s in 2010 and more than 140 000 Gbit/s in 2013 (Chart 1.8, left). The average annual growth over this period amounted to 45 per cent, reflecting the strong investment in backbone infrastructure in all parts of the world. Growth in international bandwidth has been strong in all regions, and the share of developing countries in total international bandwidth increased from around 9 per cent in 2004 to almost 30 per cent in 2013. Europe leads by far in terms of international Internet bandwidth, accounting for more than 50 per cent of the world's total (2013), compared with Africa's share of less than 1 per cent (Chart 1.8, right).

Europe's leadership in international Internet bandwidth is explained by the advanced level of broadband adoption and usage in the region, and its composition, Europe being made up of countries that are relatively small in geographic size and depend on international connections to reach the global Internet. As a result, the Internet backbone network in the region is interlinked by means of several Internet exchange points (IXPs) that interconnect national networks and give them access to the global Internet. Indeed, some of the world's largest IXPs are located in Europe and have an international reach, such as for instance the German Commercial Internet Exchange (DE-CIX), the Amsterdam Internet Exchange or the London Internet Exchange.[6] The United Kingdom stands out as a prominent global hub for international

Chart 1.8: Total international Internet bandwidth (Gbit/s), by level of development (left) and regional share (right), 2004-2013



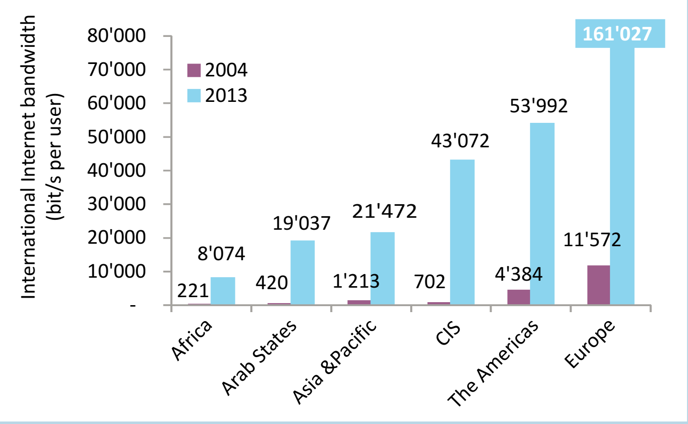


Source: ITU World Telecommunication/ICT Indicators database.

connectivity, because of the strong internal demand and also its location: most transatlantic submarine cables land in the UK, as do several cables linking Western Africa and the Arab States with Europe.[7] International Internet bandwidth in the UK accounts for almost twice as much as Africa, Arab States and CIS combined, and almost 20 times as much as the Africa region.

In order to understand better the impact of available international bandwidth on Internet usage, which differs widely across regions and countries, Chart 1.9 shows bandwidth per Internet user. This indicator has increased significantly between 2004 and 2013. There are huge differences, however, between developed and developing regions, with almost five times as much international bandwidth per user available in the former compared to the latter (106 000 vs 23 000 bit/s per user). Looking at regional differences, Europe stands out by far with around 160 000 bit/s per user in 2013 compared to the global average of 52 000 bit/s per user, followed by the Americas with 54 000 bit/s per user.

Chart 1.9: International Internet bandwidth (bit/s) per Internet user, by region, 2004 and 2013



Source: ITU World Telecommunication/ICT Indicators database.

Households with Internet access

Household access to the Internet is the ultimate way of guaranteeing an inclusive information society in which all people, irrespective of age, gender, employment status, etc. or possible level of disability, can access the Internet within the privacy and proximity of their own home. A policy aimed at universal access to broadband Internet will eventually ensure access for all households nationwide. Household access is also mostly shared access, whereby all family members can use the same service and share the subscription fees.

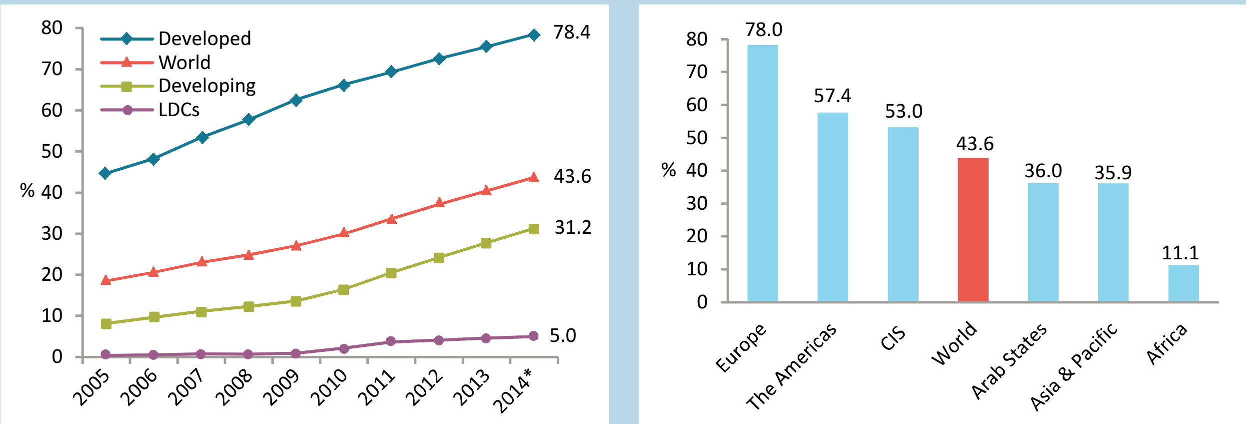
The latest ITU data show that by end 2014, almost 44 per cent of the world's households will have Internet access at home, up from 40 per cent one year earlier and 30 per cent four years earlier (Chart 1.10). Household Internet access is growing steadily, and strongly, at 9 per cent over the past year. Global growth is mostly driven by developing countries, where household Internet access is growing at 14 per cent as compared with around 4 per cent in developed countries. By end 2014, 78 per cent of households in developed countries will have Internet access, compared with 31 per cent in developing countries and 5 per cent in LDCs. In absolute terms, the number of households with Internet access in developing countries surpassed those in developed countries in 2013, and doubled between 2010 and 2014.

A comparison across regions reveals huge differences: while 78 per cent of households in Europe have Internet access and numbers are approaching saturation rates (with 2.4 per cent growth in 2014), only 11 per cent of households in Africa have Internet, and growth remains at a high 18.4 per cent, which is more than twice the world average growth rate.

The Asia and the Pacific region boasts the highest number of households with Internet access in absolute terms, with close to 350 million estimated by end 2014, i.e. almost as many as in the Americas and Europe combined. However, the large majority of them are in China and India. If we take out these, the two largest countries, the number of households with Internet access in the region amounts to (only) 109 billion. Penetration rates in the Asia and the Pacific region are well below the global average and some two-thirds of the household in the region are not yet connected to the Internet.

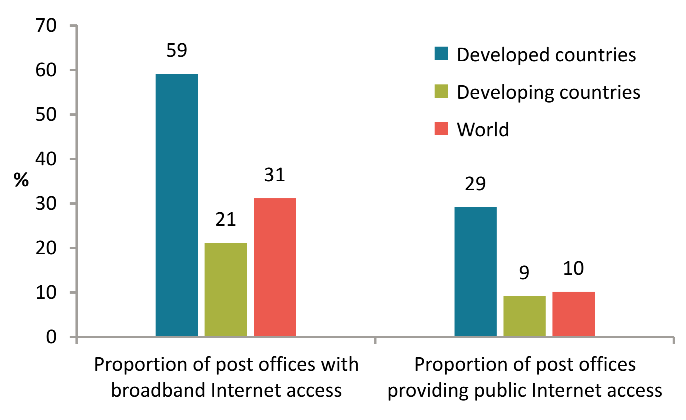
As is the case with other indicators, there is a significant urban-rural divide when it comes to household Internet access. In countries where data are available, rural household access falls far below urban household access, with differences ranging from 4 per cent (meaning that household Internet penetration in urban areas is 4 per cent higher than in rural areas) in highly developed countries such as Japan and the Republic of Korea to 35 per cent in developing countries such as Colombia and Morocco. In Guatemala, urban households are 12 times more likely to be connected to the Internet than rural households (Partnership, 2014).[8] Available data also show that Internet access in rural households is growing slowly,

Chart 1.10: Percentage of households with Internet access, by level of development, 2005-2014 (left) and by region, 2014* (right)



Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

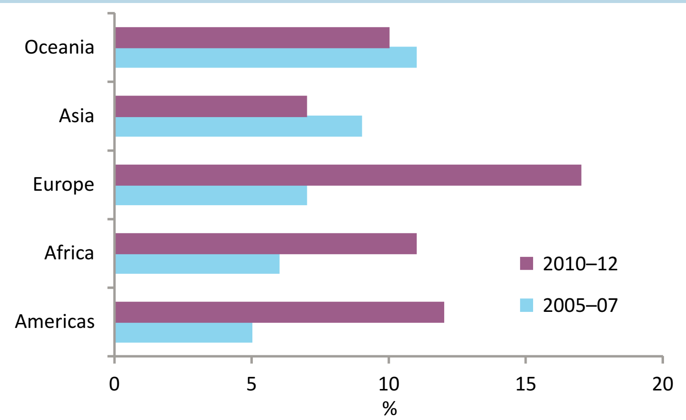
Chart 1.11: Proportion of post offices providing public Internet access and post offices with broadband Internet access, 2012, by level of development



Note: Simple averages.
Source: UPU.

much more so than urban access, leading to a widening gap. In low-income countries and LDCs, the differences are presumably even more pronounced, but data are not readily available for those countries. As has been illustrated earlier, network deployment is still limited and affordable services are much less available in rural areas, thus preventing rural households from purchasing Internet services. At the same time, the benefits brought by ICTs

Chart 1.12: Proportion of post offices providing public Internet access, by region, 2005-2007 vs 2010-2012



Note: Simple averages.
Source: UPU.

and the Internet are especially impactful in rural areas, which often also lack access to other infrastructure and public services. Therefore, connecting rural households to broadband networks should remain a priority for policy-makers in all countries.

In view of these divides and the low level of household Internet access in rural areas of developing countries, public access to the Internet plays a greater role in those areas. Data on public access is collected by ITU through its household questionnaire, but only few countries report data on this indicator, let alone broken down by urban and rural populations. Public access can be provided by commercial facilities, such as privately operated Internet cafes, as well as community-type facilities, which typically provide Internet access free of charge. Schools also constitute an important location for Internet access, especially in rural areas, although access is often limited to students and teachers and restricted to certain hours (see section 1.5).

Public libraries and post offices can play a major role in terms of providing access to the Internet: they are open to the public, their branches are widespread throughout the country and they constitute an established source of information and communication.

Research has shown that the potential of libraries and post offices to provide public Internet access is currently not yet fully tapped (Partnership, 2014). For example, worldwide, only 10 per cent of post offices provide public access to the Internet, even though 31 per cent of post offices have a broadband Internet connection (Chart 1.11), with major differences across regions (Chart 1.12). These numbers refer to 2012, and have most probably increased somewhat today. Nevertheless, there is huge potential if all post offices were provided with broadband Internet and offered this as a service to the public. According to the Universal Postal Union (UPU), increasing the proportion of post offices offering public Internet access to over 45 per cent would ensure that up to a third of all rural areas and small towns had access to the Internet, while with 60 per cent coverage half of all rural areas would be connected.[9]

The World Report series published by the International Federation of Library Associations and Institutions Committee on Freedom of Access to Information and Freedom of Expression (IFLA/FAIFE) contains information about the extent and growth of public access to the Internet in public libraries from 2007 to 2009.[10] While the results point to improvements in providing public Internet access in public libraries, progress has not been visible everywhere. Significant differences exist between developed and developing countries in terms of the provision of public Internet access, and there are still a number of countries reporting low rates of public access.

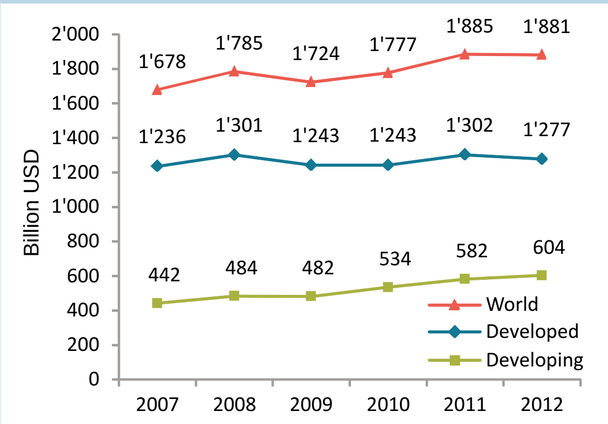
1.4 Revenue and investment in the telecommunication sector

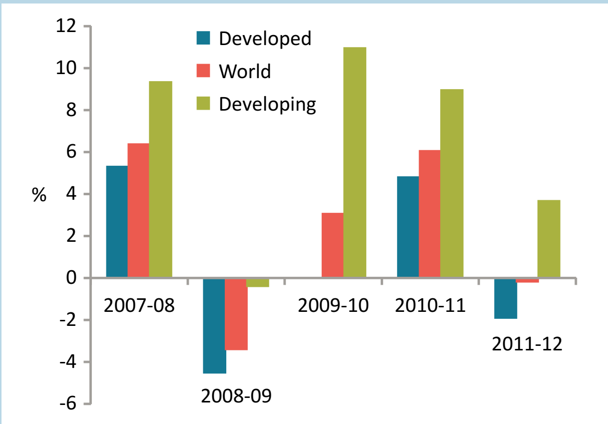
In 2012, total telecommunication revenue stagnated at around USD 1.88 trillion, or 2.7 per cent of world GDP (Chart 1.13).

After the slump experienced during the financial crisis in 2008-2009, in developed countries the sector saw some signs of recovery in 2011, with a growth in revenues of 5 per cent, but returned to negative growth in 2012 (-2 per cent). The evolution of telecommunication revenues in developed countries follows the overall pattern of their economies as a whole (in the European Union, for instance, GDP increased in 2011 and decreased in 2012)[11] suggesting that there is a link between a country's economic situation and consumer spending on telecommunication services. In addition to the adverse economic context, the voice market in developed countries is declining or reaching saturation; and the developments observed in broadband markets are taking place in competitive environments, thus also exerting pressure on the revenues generated by the strongest growing market segments, such as mobile broadband.

In contrast to the situation in the developed world, developing countries saw a 4 per cent growth in telecommunication revenues in 2012, hence mitigating the global decrease in revenues experienced in 2012. This confirms the steady progress of telecommunication revenues seen

Chart 1.13: Telecommunication revenues, world and by level of development, 2007-2012, total in USD (left) and annual growth (right)





Note: 'World' includes 103 countries accounting for 96 per cent of world GDP. 'Developed' includes 40 developed countries accounting for 99 per cent of total GDP in the developed world. 'Developing' includes 63 developing countries accounting for 89 per cent of total GDP in the developing world.
Source: ITU.

in developing countries in the period 2007-2012 (6 per cent compound annual growth rate), except for a slight dip in 2008, which coincided with the most turbulent period of the global financial crisis. As a result, the developing countries' share of total telecommunication revenues increased from 26 per cent in 2007 to 32 per cent in 2012, thus approaching their share in global GDP, which amounts to 36 per cent. This testifies to the growing importance of the telecommunication sector in the economic growth of the developing world. For example, in the recent revision of Nigeria's GDP, it was found that the telecommunication industry accounted for more than a quarter of the upgrade in GDP.[12] Despite the progress seen in several developing countries, there remains huge untapped potential in the 4 billion people not yet online in the developing world.

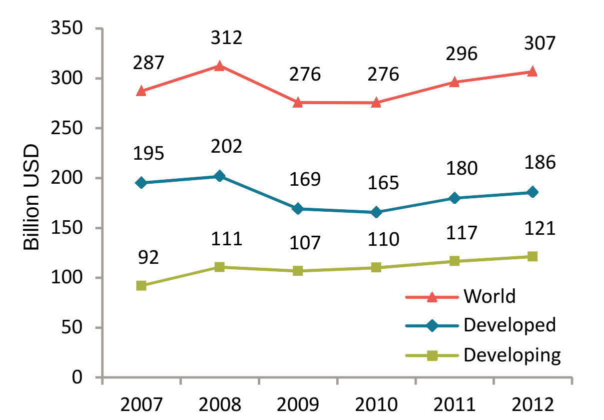
Chart 1.14 shows the evolution of investment in telecommunications, which is fundamental to supporting ICT uptake and innovation. In 2012, investment grew by 4 per cent to USD 307 billion globally. Despite the progression seen in global investment since 2010 (6 per cent compound annual growth rate), the 2008 investment levels have not been restored.

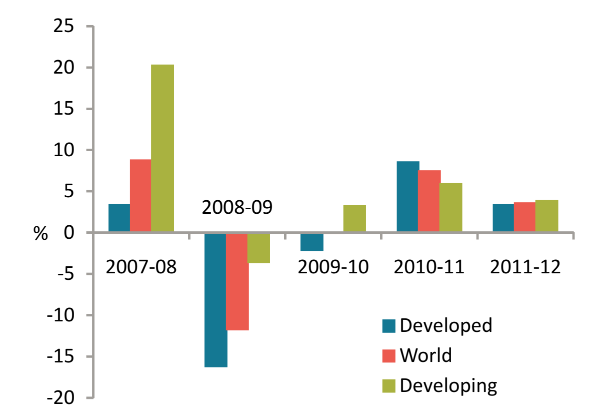
The recovery of investment levels has been hampered by the situation in developed countries, where the downturn experienced in 2008 was strongest (-16 per cent) and the reduction in telecommunication investment persisted in 2009 (-2 per cent). The overall economic environment of restricted access to capital markets and the efforts of some operators to reduce debt exposure explain the sluggish investment levels seen in 2011 and particularly in 2012.[13]

In developing countries, investment in telecommunication infrastructure and services has been more stable, with a smaller drop in 2008 (-4 per cent) and moderate growth in the following years (4 per cent compound annual growth rate between 2009 and 2012). This led to the 2008 investment levels being restored by 2011, and an all-time high of USD 121 billion at end 2012. The developing countries' share of total investment was almost 40 per cent in 2012, which is relatively high compared with the share of global telecommunication revenues generated in developing countries (32 per cent).

The investment-to-revenue ratio in the telecommunication sector stood at 17 per

Chart 1.14: Annual investment by telecommunication operators, world and by level of development, 2007-2012, total in USD (left) and annual growth (right)





Note: 'World' includes countries accounting for 91 per cent of world GDP. 'Developed' includes 35 developed countries accounting for 98 per cent of total GDP in the developed world. 'Developing' includes 45 developing countries accounting for 80 per cent of total GDP in the developing world.
Source: ITU.

cent in 2012. This means that, on average, for each USD 100 generated globally by telecommunication services, USD 17 were reinvested in capital expenditure (i.e. in upgrading the fixed assets needed to extend and improve telecommunication services). The investment-to-revenue ratio was somewhat lower in developed countries (15 per cent) than in developing countries (22 per cent). In other words, the investments made in developing countries were larger relative to the revenues they generated. This may be explained by two factors. On the one hand, telecommunications is a capital-intensive industry and part of the capital investments are delivered by global equipment providers, resulting in only limited investment cost reductions across countries.[14] On the other hand, revenue per user in several developing countries is constrained by low income levels, which limit the margin for revenue growth.[15] These constraints call for innovative approaches in the developing world, such as for instance public-private partnerships, in order to provide incentives for operators to make the investments necessary to bridge the infrastructure gap between developing and developed countries.

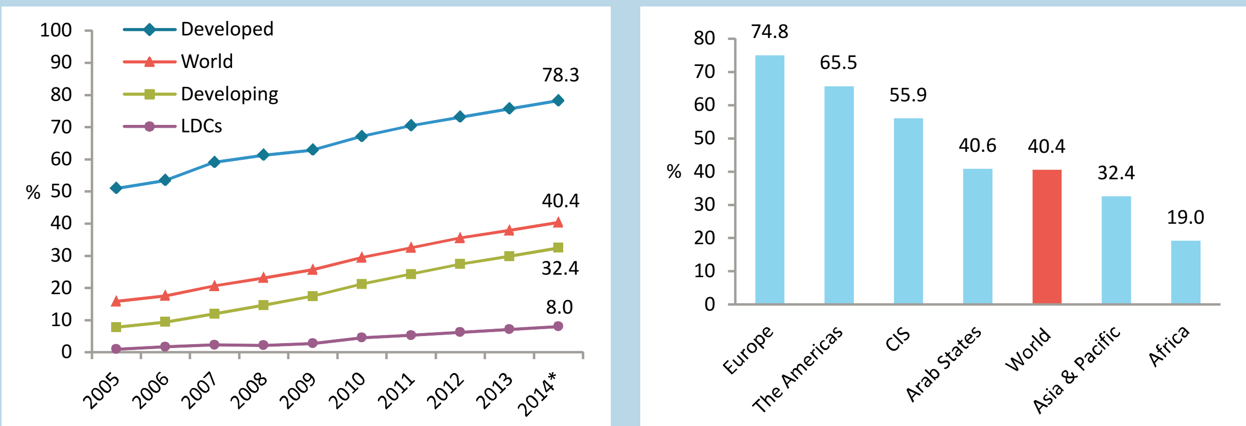
1.5 Use of ICTs

Internet users

ITU estimates that, by end 2014, almost 3 billion people will be using the Internet, corresponding to a global penetration rate of 40.4 per cent (Chart 1.15). This compares to 2.7 billion people and 38 per cent penetration a year earlier, and 2 billion people and 30 per cent penetration four years earlier. The numbers also show that there are still 4.3 billion people worldwide who are not yet using the Internet, 90 per cent of whom live in the developing world. While more than three out of four people are online in the developed countries, one out of three is online in the developing world.

Nevertheless, Internet usage is growing steadily, at 6.6 per cent in 2014 – 3.3 per cent in developed countries and 8.7 per cent in developing countries. Indeed, in developing countries, the number of Internet users will have doubled in five years (2009-2014), and two-thirds of today's Internet users live in the developing world. Growth rates are highest in LDCs (13 per cent in 2014), but they are starting from low

Chart 1.15: Individuals using the Internet, by level of development, 2005-2014 (left) and by region, 2014* (right)



Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

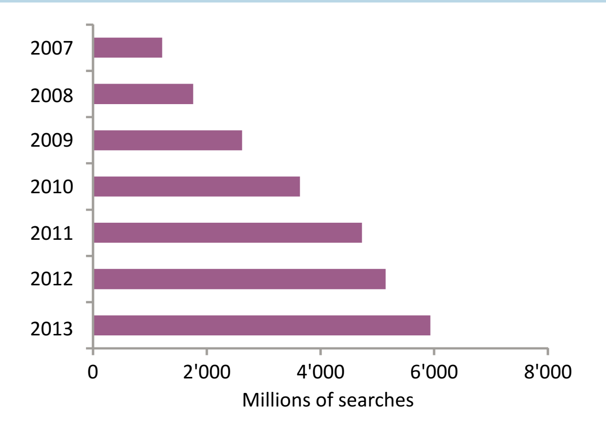
values: by end 2014, only an estimated 8 per cent of the population in LDCs will be online.

Internet usage varies considerably across regions. In Europe, Internet usage on average is approaching saturation levels, with almost 75 per cent penetration and low growth of 2.3 per cent during the past year. In Africa, the region with the lowest Internet penetration rate (19 per cent), Internet usage is growing strongly at 13 per cent, and almost twice as many people will be online by the end of this year compared with only four years earlier.

The Asia and the Pacific region includes the two most populous countries, China and India. Therefore, it comes as no surprise that 45 per cent of the world's Internet users live in this region. The two countries combined are home to around 860 million Internet users, almost 30 per cent of the world's total and 66 per cent of Internet users in the Asia-Pacific region. Penetration rates in the two countries differ greatly, though, reflecting their overall differences in income and other development indicators: while the percentage of Internet users in China is 46 per cent, it is only 18 per cent in India.

Internet usage in the Americas region is relatively high: with almost 66 per cent penetration,

Chart 1.16: Growth in daily Google searches, 2007-2013



Source: Partnership (2014), based on http://www.statisticbrain.com/google-searches/.

it is much higher than household Internet access (57 per cent). This suggests that shared household access as well as access outside the home is more common in the region. A similar situation can be observed in Africa, with 19 per cent Internet penetration compared with 11 per cent of households with Internet access. In view of infrastructure limitations and a lack of affordable services, people are more likely to use the Internet at locations outside the home, such as at work, school or public access facilities.

Internet content and use of social media

The growth in Internet users has witnessed a parallel, steep growth in the volume of Internet content. More and more people are actively participating in the information society by creating, sharing and uploading content and using social media and other Internet-based applications, covering a large range of topics and sectors. While measuring online content and website use is a challenging task on account of the sheer volume of information available, an attempt to do so has been made by the Partnership on Measuring ICT for Development in its final review of achievement of the WSIS targets, which includes an assessment of Internet content (Partnership, 2014). Some key findings featured in the report are presented below.

Over the past decade, the number of websites has been growing at exponential rates and, according to estimates by Netcraft, there were over 850 million hostnames and approximately 185 million active sites at the beginning of 2014. Google remains the leading search engine in most countries, and accounts for around 90 per cent of the search market.[16] The number of daily Google searches reached almost 6 billion by end 2013 (Chart 1.16) and the total number of searches made through Google in 2013 exceeded 2 trillion.

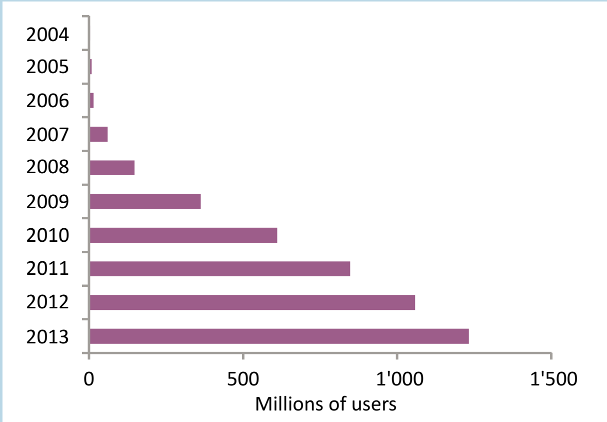
Social media sites have become the most accessed websites by users in both developed and developing countries. Since its creation in 2004, Facebook has grown to comprise 1.3 billion active users by end 2013, a growth of 22 per cent over the past year (Chart 1.17), although a single user could be operating several accounts and therefore the numbers do not represent unique Internet users (ITU, 2011). Twitter, the leading international microblogging service, founded in 2007, has grown to comprise 646 million active registered users by end 2013 (and 115 million active monthly users), and some 58 million tweets were posted daily in the past year.[17] The Chinese microblog service Tencent Weibo accounts for a further 507 million subscribers, out of an estimated 582 million Chinese Internet subscribers (Partnership, 2014).

More than 6 billion hours of video are being watched each month and more than 100 hours of video content are uploaded every minute on YouTube, the leading international video-filesharing site with services in 61 countries. As of early 2014, YouTube boasted more than 1 billion unique visitors monthly.

Other top popular websites include Amazon, Wikipedia and LinkedIn as well as various news and online e-market sites at the national level (see below on e-business). Wikipedia, the largest and most widely used online encyclopaedia, featured more than 30 million articles by end 2013 (Chart 1.18). Articles are now available in 287 languages across 30 million pages of content. By February 2014, Wikipedia registered more than 20 billion page views per month by Internet users. At the same time, the proportion of articles in English has decreased significantly – from 46 per cent in 2003 to 15 per cent in 2013 – while those in other languages have increased accordingly, although pages viewed are still predominantly in English and the proportion of contributors writing in English is more than 50 per cent.

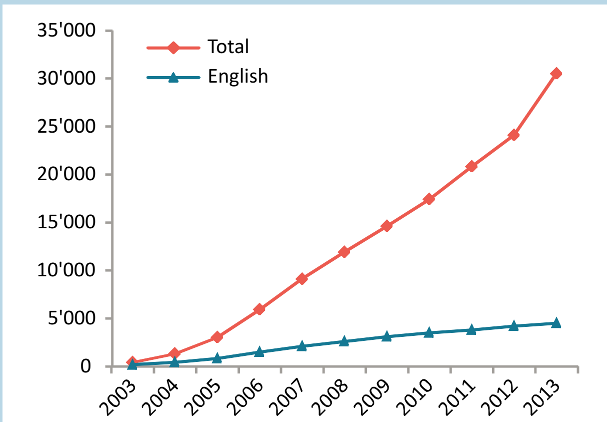
While these numbers illustrate the huge increase in Internet content and usage overall, a more nuanced analysis needs to be carried out to identify digital divides. Table 1.2 shows that, for example, domain-name registrations are still dominated by content providers in developed countries, which account for over 80 per cent in 2013. Domain-name registrations from Africa account for less than 1 per cent. The data include both global top-level domain (gTLD) and country code top-level domain (ccTLD) registrations, and there are comparability issues related to registries across countries. Nevertheless, they offer an indication of the amount of online

Chart 1.17: Growth in Facebook monthly active users, 2004-2013 (millions of users)



Source: Partnership (2014), based on http://www.theguardian.com/news/datablog/2014/feb/04/ Facebook-in-numbers-statistics, accessed 6 March 2014. Data sourced from Facebook.

Chart 1.18: Wikipedia articles – total and English language, 2003-2013 (thousands of articles)



Source: Wikipedia statistics at http://stats.wikimedia.org/EN/TablesArticlesTotal.htm.

Table 1.2: Total Internet domain registrations by world region, 2003, 2008 and 2013

	2003		2008		2013	
	Millions	%	Millions	%	Millions	%
World	**59.7**	**100.0**	**173.4**	**100.0**	**245.2**	**100.0**
Developed	49.6	82.9	135.9	78.4	197.4	80.5
Developing	7.1	11.8	34.7	20.0	45.0	18.4
Other/Unknown	3.1	5.2	2.8	1.6	2.7	1.1
Africa	0.3	0.5	1.0	0.6	2.3	0.9
Americas	23.9	40.1	71.8	41.4	98.9	40.4
Asia	5.3	8.9	29.8	17.2	36.9	15.0
Europe	25.8	43.3	63.7	36.8	98.0	40.0
Oceania	1.2	2.1	4.2	2.4	6.4	2.6

Source: Partnership (2014). Data supplied by ZookNIC, compiled from ccTLD and other sources. Figures exclude fifteen ccTLDs which act as virtual gTLDs.

content generated by countries and regions and highlight the differences.

E-business

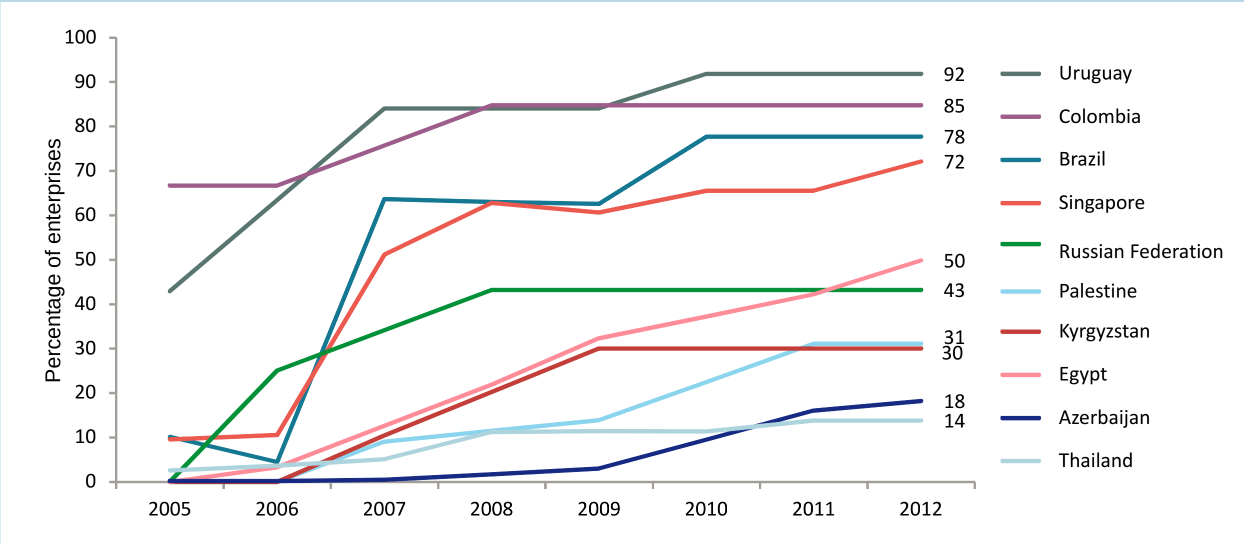
Private-sector enterprises are early adopters of ICTs, and are driving the information economy across the globe by providing online services and content, engaging in e-business at both the wholesale and retail levels, and transforming entire business sectors and creating new value chains through the use of ICTs. The diffusion of ICTs in the economy has been found to facilitate macroeconomic performance and business growth by increasing labour productivity, enlarging enterprises' market reach, saving costs and driving innovation (Partnership, 2014).

International data on ICT access and use by enterprises are collected annually by the United Nations Conference on Trade and Development (UNCTAD), but availability is limited apart from the European region where countries carry out annual surveys on the use of ICTs in enterprises (compiled by Eurostat). The latest results show that in Europe Internet access in enterprises stood at 95 per cent in 2012 (up from 94 per cent a year earlier) and appears to have reached saturation levels. Internet access varied from 79 per cent in Romania to 100 per cent in Finland, Lithuania and the Netherlands. The proportion of businesses with websites was lower, accounting on average for 71 per cent and ranging from 36 per cent in Romania to 91 per cent in Finland.

In addition to regular business functions carried out over electronic networks, a recent Eurostat survey revealed that more and more enterprises are making use of social media. In 2013, around 30 per cent of European enterprises used social media, ranging from 15 per cent of enterprises in Latvia to 55 per cent in Malta.[18] Activities are mostly related to social networks (e.g. Facebook), followed by multimedia content sharing websites (e.g. YouTube) and blogs (e.g. Twitter).

In the developing world, data on ICTs in enterprises are scarce and only collected by few countries. The proportion of businesses with Internet access varies between 48 per cent in Azerbaijan and 97 per cent in Lebanon.[19] Of these, not all have broadband access, which is essential to enable businesses to engage in, and take full advantage of, the potential of e-business (Chart 1.19). In addition, Internet access differs enormously according to the size and location of the enterprise – small and

Chart 1.19. Fixed-broadband access in enterprises using the Internet, selected countries, 2005-2012



Source: UNCTAD Information Economy Database, 2014 , available at unctadstat.unctad.org.

micro businesses are much less connected than large enterprises, and rural enterprises are less connected than urban enterprises (Partnership, 2014). As has been shown earlier in this chapter, backbone connectivity and international Internet bandwidth is still lacking in many regions of the developing world. Access to high-speed quality broadband services, however, is especially important to the business sector, in the same way as other basic infrastructure and services necessary to run a successful business.

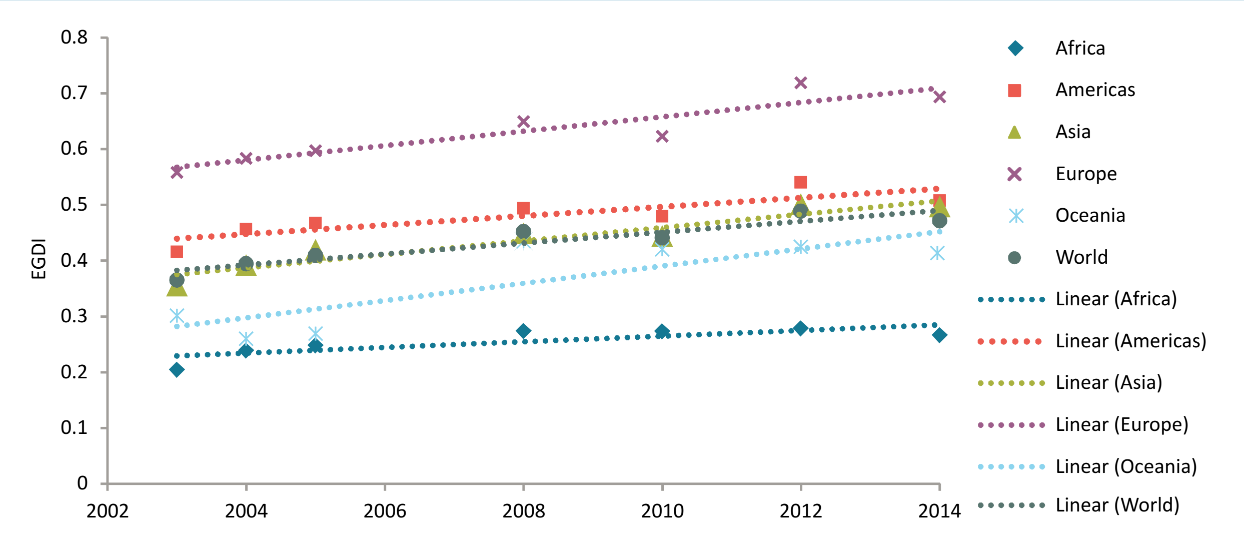
E-government

Not only are government entities major users of ICTs, but governments are also increasingly using the Internet to provide services to their citizens. E-government contributes to increased efficiency and greater transparency and accountability in government, reduces cost and improves service delivery.

There is little data on the use of ICTs by government organizations, and those countries that do have data are usually the more advanced ones with high levels of connectivity in general. More information is available about government services provided online, tracked by the United Nations through its E-government Survey, which is carried out every two years. The latest data show that, today, governments of all countries have established central websites and that more than 50 per cent of countries provide links to local and/or regional government agencies' sites (UNDESA, 2014). Efforts are still needed to connect lower-tier administrations in countries.

When it comes to the provision of e-services, the results from the latest UN survey show that considerable progress has been made over the past decade. For example, online information and services on government website portals increased threefold, with 70 per cent of countries providing a one-stop shop portal in 2012, as against 26 per cent in 2003. By 2014, all countries had a government web presence, and almost all countries in Europe – and the majority of countries in the Americas and Asia – provided online information on education, health, social welfare, finance and labour. In Africa, 31 per cent of countries provided online information on social welfare and 65 per cent on finance (Partnership, 2014).

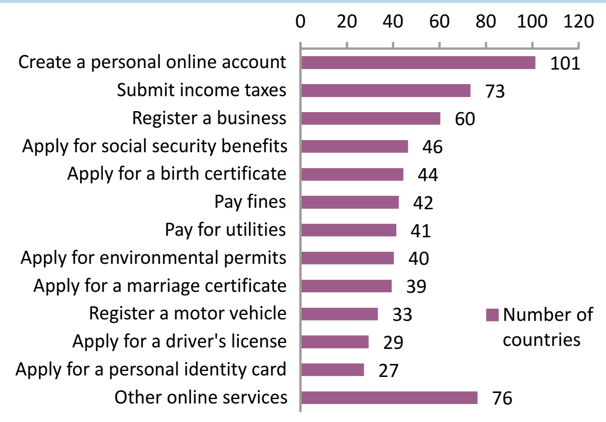
Chart 1.20: E-government Development Index (EGDI), 2003-2014

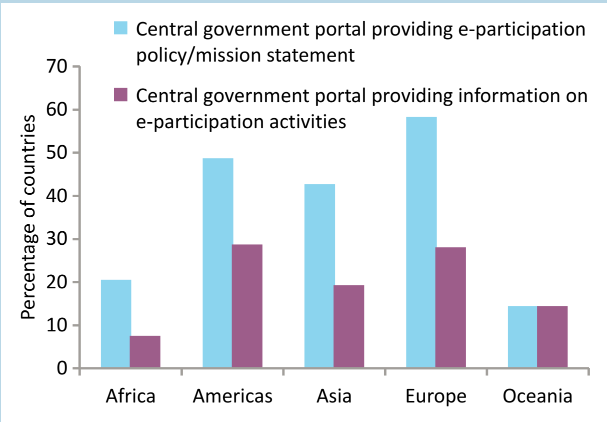


Source: UNDESA. Data from United Nations E-government Survey (2014).

Over the past decade, the UN E-government Development Index (EGDI)[20] has been rising in all regions (Chart 1.20), and more and more countries are providing e-government transactional services and e-participation services (Chart 1.21). Despite the major progress made, disparities remain in the use of ICTs in government across countries. As illustrated in Chart 1.20, Europe tops the E-government Development Index, followed by the Americas and Asia, whereas Oceania and Africa remain below average. In particular, progress in Africa has been slower compared to other regions. This is consistent with the results of the ICT Development Index (IDI) (see Chapter 2), and given that ICT performance and skills levels are also part of the E-government Development Index.

Chart 1.21: E-government services provided by countries (transactional services, left, and e-participation services, right)





Source: UNDESA. Data from United Nations E-government Survey (2014).

Transactional services are relatively advanced services that are increasingly being provided by governments. For example, income-tax forms can be submitted online in 73 countries, registering a business can be carried out online in 60 countries, and people can apply for birth certificates online in 44 countries. Countries in Europe are most advanced when it comes to transactional services and e-participation services (Chart 1.21). While, globally, around 20 per cent of countries provided information to their citizens on national e-participation policies in 2013, in Europe the proportion was nearer to 60 per cent.

ICT use in schools

Providing schools with Internet access (in particular broadband Internet) is a basic infrastructure requirement in today's information society. Access to high-speed Internet is necessary to enable students to use the Internet for educational purposes, and helps enhance education administration through the electronic exchange of forms, data and other information. Internet access in schools also achieves cost efficiencies by automating manual tasks and reducing expenses associated with the printing and distribution of textbooks. The benefits are particularly attractive for remote schools, where Internet access provides the vehicle for online learning and access to educational content.[21]

In addition to the educational benefits resulting from the use of ICTs in schools, in remote and rural areas schools are indeed often the only place where young people can use the Internet (see section 1.3 above). Therefore, they can also play an important role in terms of providing Internet access to people living in unconnected households.

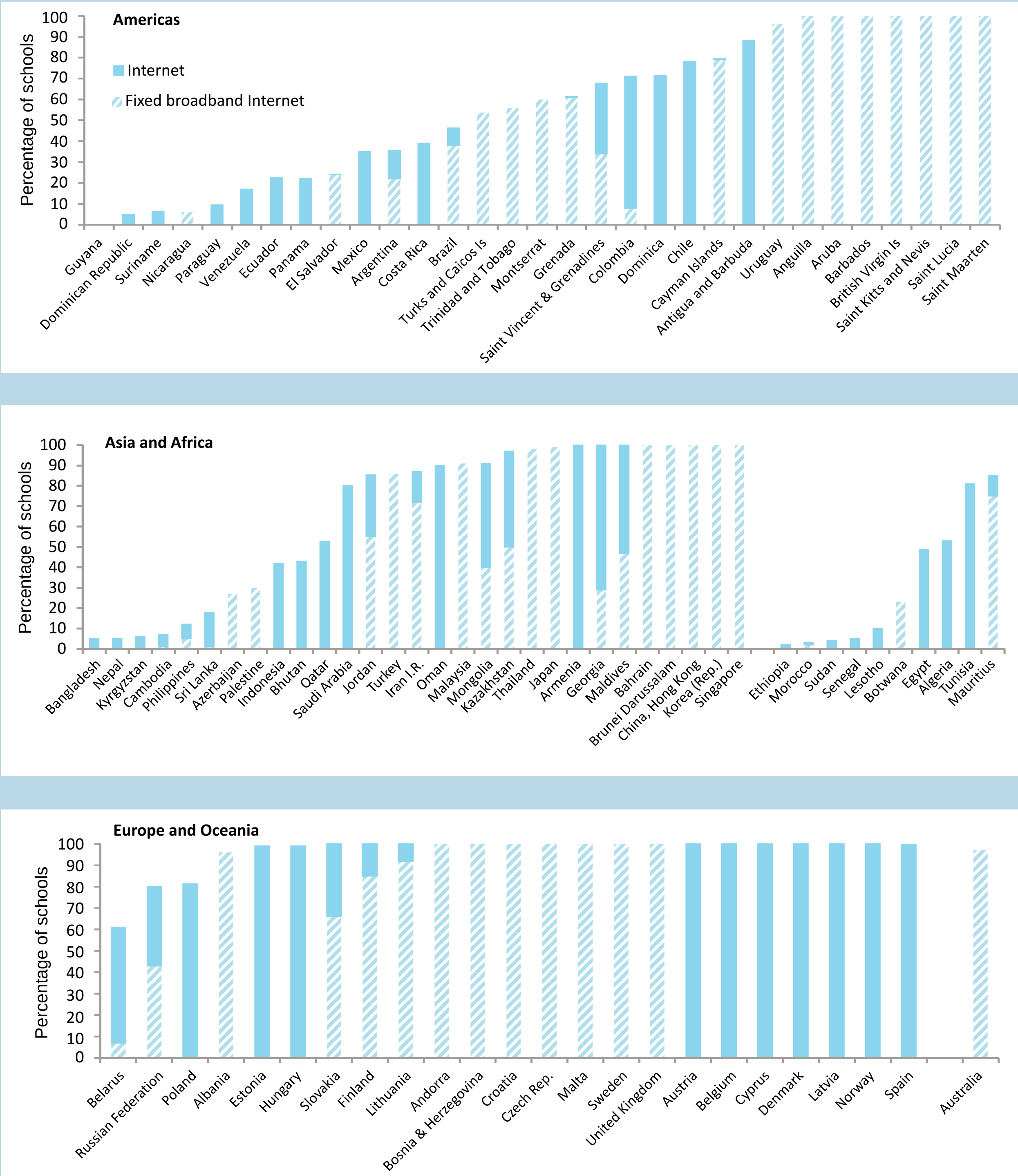
The latest available data from the UNESCO Institute for Statistics (UIS)[22] show that, in developed countries, the vast majority of schools have Internet access, to the extent that some countries no longer track this indicator, having reached 100 per cent connectivity (Chart 1.22). Nevertheless, there are some countries, such as Poland and the Russian Federation, where school connectivity stands at around 80 per cent, compared with 100 per cent in most other developed countries for which data are available.

In developing countries, school access to Internet is lower on average, although much progress has been made in recent years. There are significant differences across countries, even within the same region and with similar income levels. For example, in the Americas region, only 5 per cent of schools in the Dominican Republic had Internet access in 2012, as against 100 per cent on several Caribbean islands. Argentina, Brazil, Costa Rica and Mexico all had less than 50 per cent of schools connected, compared with 78 per cent in Chile and a high of 96 per cent in Uruguay. In Asia, Thailand stands out with almost 100 per cent school connectivity, as does Mongolia, a country with one of the lowest population densities in the region. Bhutan, an LDC, also features relatively high school connectivity, at 43 per cent, much higher than other LDCs such as Bangladesh (5 per cent), Cambodia (7 per cent) or Nepal (5 per cent). In Africa, Mauritius and Tunisia also enjoy very high levels of school connectivity in relation to their income levels.

Chart 1.22 also shows the type of Internet access schools have, in particular the share of fixed-broadband access. In some countries, the proportion of schools with fixed-broadband Internet access (out of all schools with Internet access) is still low, suggesting that, in those countries, many schools have connections at only narrowband speed. However, since the statistics date back a few years, and given the growth of mobile-broadband services, it may be expected that more and more schools will have broadband access in the near future and that the numbers will evolve significantly.

Government policies and projects, sometimes in cooperation with the private sector, can exert a strong impact on the level of connectivity of

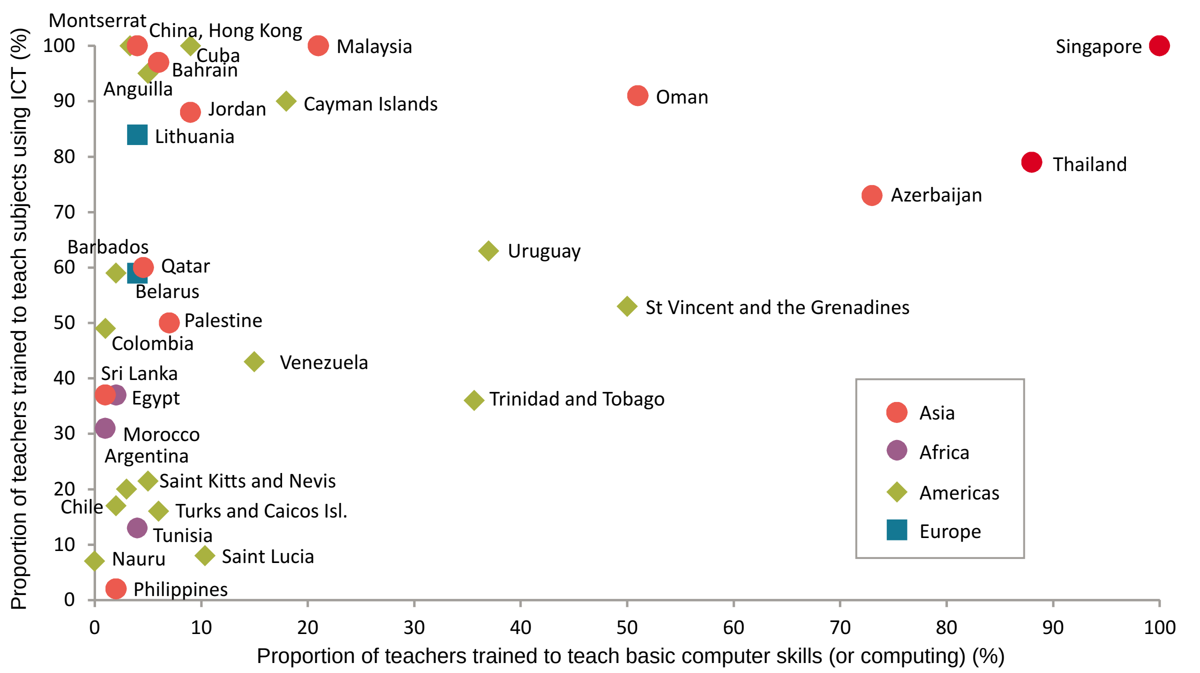
Chart 1.22: Proportion of schools with Internet access (total and fixed-broadband), 2012 or latest year available



Note: Data on broadband in secondary schools in Bangladesh are not available. Data for Nicaragua, Philippines and Indonesia do not include upper secondary. Data for European countries and Costa Rica refer to lower secondary. Data for Guyana, Nicaragua and Indonesia refer to primary and lower secondary. Data for Cambodia include pre-primary schools. Data for Morocco, Tunisia, Guyana, Montserrat, Dominican Republic, Nicaragua, Colombia, Trinidad and Tobago, Bangladesh, Philippines, Sri Lanka, Azerbaijan, Bhutan, Cambodia, Kazakhstan, Malaysia, Maldives, Singapore, Belarus and the Russian Federation refer to public schools. In Suriname, there are no private schools in upper secondary. Data for Palestine refer to West Bank schools only.

Source: UIS database, Partnership on Measuring ICT for Development WSIS Targets Questionnaire, 2013.

Chart 1.23: Proportion of ICT-qualified teachers versus proportion of teachers trained to teach subjects using ICTs, by region, 2009-2012



Note: Data for Philippines refer to primary and lower secondary. Data for Venezuela refer to primary only. Data for Montserrat and Saint Lucia refer to secondary only. Data for Palestine refer to West Bank schools only. Data for Bahrain, Belarus, Morocco and Tunisia refer to 2008. For Morocco, ICT-qualified teachers figures refer to 2008. Data for Azerbaijan, Barbados, Jordan, Saint Lucia, Singapore, Trinidad and Tobago, Uruguay, Philippines and Sri Lanka refer to public schools only.

Source: UIS database, Partnership Questionnaire on WSIS Indicators, 2014.

schools, and explain some of the differences across countries. In Uruguay, the *El Ceibal* initiative has driven ICT usage in schools, in partnership with the One Laptop per Child (OLCP) project. Similarly, in Chile, the *Enlaces* initiative, which partners with the private sector, has been very effective in improving Internet access in schools, resulting in 78 per cent of schools being connected to the Internet in 2013, compared to just 44 per cent in 2009 (Partnership, 2014). Finally, Thailand's SchoolNet programme, which was implemented from 1996 to 2003 and was followed by the EdNet programme, contributed significantly to increasing Internet access in schools nationwide, and the country's more recent One Tablet per Child (OTPC) initiative has helped increase the learner-to-computer ratio in schools.

Internet connectivity in schools also depends on the development of the national telecommunication infrastructure and on whether service providers have reached out to rural and sometimes geographically difficult areas with low population density (Partnership, 2014). As discussed earlier in this chapter, rural areas often suffer from much lower network coverage and hence ICT uptake compared with urban areas.

While connecting schools to the Internet and other ICTs is essential in order to foster e-education, it is equally important to look at how the technologies are used for educational purposes by both teachers and students. In some cases, computers have been introduced in schools without Internet access, which effectively limits their use and impact. In other cases, a lack of qualified ICT teachers and of teachers that have been trained to use ICTs to teach their subjects hampers the development of students' ICT skills and limits the educational impact that ICTs can make.

Available data collected by UIS at the international level shows that education systems in countries seem to put more emphasis on training teachers to teach subjects using ICTs than on training teachers to teach basic computer skills or computing (i.e. ICT-qualified teachers) (Chart 1.23). In most of the countries included in the chart, the proportion of ICT-qualified teachers is below 10 per cent, while a few countries have very high proportions of ICT-qualified teachers (e.g. Thailand, Singapore). It should also be noted that definitions of "ICT-qualified teachers" differ among countries, where in some cases a formal degree is required and in other cases nationally defined certificates are sufficient (Partnership, 2014).

1.6 Emerging ICT measurement issues

Determining and monitoring global ICT goals and targets

The year 2015 is imminent. It will mark the target date of the Millennium Development Goals (MDGs) set in 2000, which include, under MDG 8, the ICT-specific Target 8F: "In cooperation with the private sector, make available benefits of new technologies, especially information and communications". Likewise, 2015 will mark the date for the targets set by the World Summit on the Information Society (WSIS) and by the Broadband Commission for Digital Development.[23]

Accordingly, the process of discussing and determining the post-2015 development agenda, and setting new sustainable development goals (SDGs) for the next decade or so, will culminate in 2014. The United Nations Open Working Group (OWG) on SDGs concluded its work in July 2014. Its final report is expected to be submitted to the President of the United Nations General Assembly (UNGA) and the UN Secretary-General by August 2014. The final proposal will then be considered by UNGA at its session in September 2014.[24]

In order to ensure measurability, the official statistical community provided support in the design of the SDGs and the post-2015 development agenda. In March 2014, the Chair of the United Nations Statistical Commission (UNSC) submitted an input document to OWG comprising 29 statistical notes, providing measurement information on the 29 issues discussed during the group's first eight sessions. The inputs were prepared in cooperation with the UNSC Friends of the Chair (FOC) group on broader measures of progress, which has been tasked with facilitating and providing support to the ongoing process towards a post-2015 development agenda in order to ensure that a robust statistical measurement approach is incorporated from the outset.[25] International organizations, including ITU, contributed to the preparation of the statistical notes. An additional five sessions of OWG followed until July 2014, during which 19 focus areas and eight clusters were identified.

The group's 13th and final session concluded with a proposal for a set of 17 sustainable development goals (SDGs) and 169 targets, which were forwarded to the UN General Assembly for consideration in the post-2015 development agenda that is to be adopted in late 2015. Several of the proposed goals include targets which refer to technology and specifically ICTs, such as providing affordable Internet access in LDCs and enhancing the use of ICTs to promote women's empowerment. The document also includes two targets on data and monitoring and stresses the "need to take urgent steps to improve the quality, coverage and availability of disaggregated data to ensure that no one is left behind".[26]

The role of ICTs as a key development enabler, contributing to the acceleration of progress towards the MDGs, has been advocated by the Broadband Commission for Digital Development since its inception in 2010. In 2013, the Broadband Commission established a task force on Sustainable development and the post-2015 development agenda, to explore how broadband can best contribute to development goals. In a recent report, the task force highlights the role broadband and ICTs can play as transformative solutions for achieving sustainable development for all (Broadband Commission, 2013).

In parallel with the process of preparing the post-2015 development agenda, discussions relating to the WSIS+10 review have also gained pace during the past year, as the final target date identified in the Geneva Plan of Action also approaches rapidly. In line with the traditional WSIS multistakeholder approach, an open consultation process took place in six phases, with physical meetings held between July 2013 and May 2014, in order to prepare for the WSIS+10 High-Level Event in 2014. Delegates attending the WSIS+10 High-Level Event, which took place from 10 to 13 June 2014 in Geneva, endorsed two outcome documents, namely: the *WSIS+10 Statement on the Implementation of WSIS Outcomes*, and the *WSIS+10 Vision for WSIS Beyond 2015*, which together provide a set of fresh priorities for the further development of the information society and reaffirm the importance of ICTs as cross-cutting enablers for achieving the three pillars of sustainable development: economic growth, environmental balance and social inclusion.

At its meeting in May 2014, the UN Commission on Science and Technology for Development (CSTD), which has been mandated by the UN Economic and Social Council (ECOSOC) to carry out a system-wide follow-up to the WSIS outcomes, considered progress made in WSIS implementation. In its resulting draft resolution, it "emphasizes the importance of information and communication technologies for development and considers that it should be reflected as appropriate in the post-2015 development agenda".[27] As in past resolutions endorsed by ECOSOC, it recognizes and appreciates the work of the Partnership on Measuring ICT for Development and encourages Member States to collect ICT data at the national level.

Monitoring progress towards achievement of the WSIS outcomes has been an integral component of the WSIS process. While WSIS itself did not put in place a formal monitoring process to track the ten targets adopted in 2003, it referred to the Partnership on Measuring ICT for Development and its contribution towards developing indicators and collecting data and statistics on ICT. Since its creation in 2004, the Partnership has played an active role in monitoring global ICT developments, culminating in the preparation of a final quantitative assessment report on achievement of the WSIS targets, which was launched at the June 2014 High-Level Event (Boxes 1.1 and 1.2).

While the future international development goals have not yet been defined, ICTs will continue to play a major role in facilitating access to information, knowledge and key services. In this context, ITU members are discussing a set of global ICT goals and targets to be achieved during the next five years (Box 1.3). The ICT sector itself will remain a major source of growth. In addition, diffusion of ICTs in the economy has been found to facilitate macroeconomic performance and business growth by increasing labour productivity, enlarging enterprises' market reach, saving on costs and fostering innovation. Access to new technologies is important for ensuring full participation by all people in new opportunities related to employment, education, health, governance or peace-building, thus accelerating progress towards the achievement of other development goals. As this report shows (Chapter 2), progress in ICT diffusion and uptake is closely linked to progress towards

Box 1.1: Final review of the WSIS targets: Achievements, challenges and the way forward

Delegates attending the WSIS+10 High-Level Event, held in June 2014 in Geneva, took stock of the achievements made since the two phases of WSIS (2003 and 2005), and endorsed two major outcome documents, namely: the *WSIS+10 Statement on the Implementation of WSIS Outcomes*, and the *WSIS+10 Vision for WSIS Beyond 2015*.

As a key contribution to this process, the Partnership on Measuring ICT for Development prepared a major ten-year quantitative assessment report, entitled *Final review of the WSIS targets: Achievements, challenges and the way forward*, which reviews progress made towards the achievement of the ten WSIS targets set out in the WSIS Geneva Plan of Action in 2003 (Partnership, 2014). For each target, the report reviews the indicators identified to measure the target, reports on progress made on the target since 2003, proposes new measurement priorities for future discussions related to the target and makes recommendations on how those priorities could be met.

The report also includes a discussion on the post-2015 development agenda, highlights the importance of ICT for development, considers lessons learnt from the WSIS monitoring process and places the WSIS targets in the context of the post-2015 development agenda. This includes a discussion of possible goals, targets and indicators for the post-2015 period.

Since its inception in 2004, shortly after the conclusion of the first phase of WSIS, the Partnership has played a key role in monitoring progress towards achievement of the WSIS outcomes, goals and targets. Its methodological work has contributed significantly to the collection of solid evidence on ICT developments worldwide, based on internationally comparable statistical indicators (see Box 1.2).

In 2010, several partners contributed to the preparation of a mid-term review of the WSIS targets (ITU, 2010). Subsequently, the Partnership launched a new task group, which developed a set of indicators to measure the ten WSIS targets. In 2011, it released the publication *Measuring the WSIS targets. A statistical framework*, which has become the main reference document for the WSIS+10 quantitative review. The final 2014 review report was prepared by the task group and coordinated by ITU. To this end, a questionnaire was sent to all countries in 2013, to collect national-level data on the indicators identified to measure the WSIS targets. The results of the survey are featured in the report, along with other data sources.

The *Final review of the WSIS targets: Achievements, challenges and the way forward* report is available at: http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wsistargets2014.aspx.

achieving other MDGs, such as those related to poverty reduction, maternal health or decent employment.

As more and more people join the information society and high-speed communication networks become an indispensable infrastructure, the tracking and measurement of ICT developments become even more relevant. Continuous monitoring and measurement of ICT developments will help to identify progress and gaps, and will guide policies to ensure equal access, use and impact in respect of ICTs.

Using different data sources and big data analytics

An important element in the discussion related to the post-2015 development agenda and the setting of measurable goals and targets has been the need to take a fresh look at the way data and statistics are collected, analysed and disseminated, in view of the large data gaps prevailing in many developing countries in basic statistics in the areas of the economy, health, education, labour, etc., all of which are crucial to monitoring the MDGs, and the future SDGs. This call for a "data revolution" was first enunciated in the report to the UN Secretary-General of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda published in 2013 (see Box 1.4 on the data revolution). Since then, it has received considerable attention within the statistical community, as well as in other circles concerned with the lack of official statistics and development data.

According to the discussions, a data revolution considers new data sources, in addition to existing official sources: besides governments, other stakeholders such as the private sector, civil

Box 1.2: A decade of successful international cooperation on ICT measurement

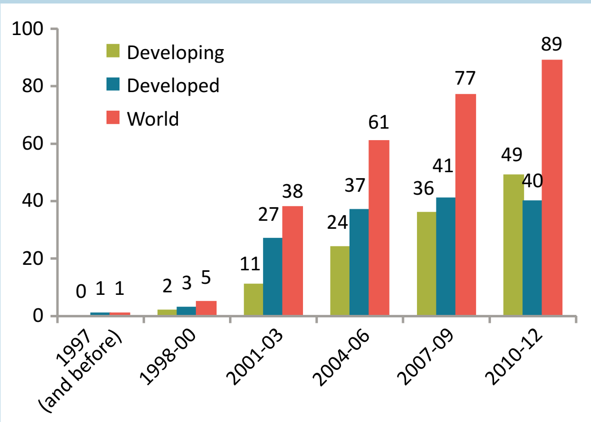
In 2004, ICT measurement was still in its infancy, with little attention paid to collecting official ICT statistics outside the member countries of the Organisation for Economic Co-operation and Development (OECD), with the exception of telecommunication statistics which have been collected by ITU for decades. In the wake of WSIS, and with the increasing focus on the opportunities offered by ICTs to developing countries, calls surfaced for reliable and comparable data in order to take stock of the emerging information society, identify digital divides and measure the developmental impacts of ICTs. In this context, the Partnership on Measuring ICT for Development was launched during the UNCTAD XI conference in June 2014, with the main objective of enhancing the availability of comparable international ICT statistics, particularly in developing countries. Initiated by UNCTAD, ITU and OECD, its membership has grown rapidly and today encompasses 13 international and regional organizations. Each member contributes to the work of the Partnership within its specific mandate and competence. A unique feature of the Partnership is that it is entirely based on voluntary contributions by its members. With a loose governance structure and no institutionalized secretariat or dedicated budget, partners have devoted time and resources in order to advance the ICT measurement agenda globally, regionally and nationally.

Ten years on, ICTs have transformed the global society and economy and the Partnership has contributed significantly to monitoring and tracking those changes, by developing new indicators and standards, providing technical assistance to developing countries and providing a forum for countries and statistical experts to discuss ICT measurement. Today, the Partnership is internationally recognized as the authoritative forum for advancing ICT measurement based on official statistics. Since its inception, ICT statistics have been a regular item on the agenda of the UN Statistical Commission (UNSC) and the Partnership has reported to UNSC on progress in its work in 2005, 2007, 2009, 2010, 2012 and 2014. Its core list of 57 ICT indicators, covering many aspects of the information society and economy, is widely used by countries in the course of their national ICT data collection. The methodological work developed by the Partnership has contributed significantly to the collection of evidence on ICT developments worldwide, based on internationally comparable statistical indicators. The work of the Partnership has also been acknowledged in ECOSOC resolutions in 2008, 2009, 2011, 2012 and 2013,[28] in the context of assessing progress made in the implementation of the WSIS outcomes.

Data availability has also increased significantly over the past decade. In particular, there are more comparable data on ICT infrastructure, household access and Internet users. For example, at the beginning of the century, only around a dozen developing countries collected data on Internet users, while today there are almost 50 developing countries collecting this indicator through official surveys (Chart Box 1.2). Data on household access to the Internet or a computer are now being collected by more than 100 economies worldwide, and data on Internet use in businesses by almost 70 countries, although not on a regular basis (Partnership UNSC 2011). Similarly, whereas no data were available on ICT access and use in schools, they have now started to be compiled in many developing countries (see section 1.5).

At the same time, major data gaps remain, in particular in developing countries and LDCs. This concerns, notably, statistics on ICT use by individuals, businesses, governments and other public-sector organizations, ICT-related employment data, as well as data related to online security and cybercrime, gender and youth, and cultural and environmental aspects. The growing information society will increasingly require more and better statistics to assess the social, economic and environmental impacts of ICTs. The Partnership, in close collaboration with national statistical systems and the international donor community, will continue its efforts to address these challenges.

Chart Box 1.2: Number of countries collecting Internet user data through official surveys, by level of development



Note: Chart shows countries that have collected data on the number of Internet users through official national surveys. Data are presented in three-year intervals and include countries that have collected data for at least one year within those intervals.

Source: ITU.

Box 1.3: Strategic targets for the future information society

As part of its strategic plan for 2016-2019, the ITU membership has been discussing a number of post-2015 global ICT goals and a set of measurable targets that would help monitor and track progress towards achieving those goals over the next five years, until 2020[29] (see Table Box 1.3). The proposed set of goals and targets are expected to be finalized at the ITU Plenipotentiary Conference which will take place in Busan, Republic of Korea, from 20 October to 7 November 2014.

Table Box 1.3: ITU goals and targets for 2020 (under discussion)

Goal 1. Growth – Enable and foster access to and increased use of telecommunications/ICTs
Target 1.1: Worldwide, 55% of households should have access to the Internet by 2020 **Target 1.2:** Worldwide, 60% of individuals should be using the Internet by 2020 **Target 1.3:** Worldwide, telecommunication/ICTs should be 40% more affordable by 2020[a]
Goal 2. Inclusiveness – Bridge the digital divide and provide broadband for all[b]
Target 2.1.A: In the developing world, 50% of households should have access to the Internet by 2020 **Target 2.1.B:** In the least developed countries (LDCs), 15% of households should have access to the Internet by 2020 **Target 2.2.A:** In the developing world, 50% of individuals should be using the Internet by 2020 **Target 2.2.B:** In the least developed countries (LDCs), 20% of individuals should be using the Internet by 2020 **Target 2.3.A:** The affordability gap between developed and developing countries should be reduced by 40% by 2020 **Target 2.3.B:** Broadband services should cost no more than 5% of average monthly income in developing countries by 2020 **Target 2.4:** Worldwide, 90% of the rural population should be covered by broadband services by 2020[c] **Target 2.5.A:** Gender equality among Internet users should be reached by 2020 **Target 2.5.B:** Enabling environments ensuring accessible telecommunications/ICTs for persons with disabilities should be established in all countries by 2020
Goal 3. Sustainability – Manage challenges resulting from telecommunication/ICT development
Target 3.1: Cybersecurity readiness should be improved by 40% by 2020[d] **Target 3.2:** Volume of redundant e-waste to be reduced by 50% by 2020 **Target 3.3:** Greenhouse gas emissions generated by the telecommunication/ICT sector to be decreased per device by 30% by 2020
Goal 4. Innovation and partnership – Lead, shape and adapt to the changing telecommunication/ICT environment
Target 4.1: Telecommunication/ICT environment conducive to innovation **Target 4.2:** Effective partnerships of stakeholders in the telecommunication/ICT environment

Note: [a]Cost of ICT services to be 60 per cent of the 2012 value. [b]Existing and additional targets for Goal 2 are being reviewed and adjusted, based on contributions from Member States. [c] Due to data limitations, currently mobile-broadband signal coverage is considering in determining this target. [d] Data being compiled by the Global Cybersecurity Index (GCI).

Source: ITU.

society and international organizations should be involved. New data sources could include big data (mostly provided by private-sector companies) which could help "improve the timeliness and completeness of data, without compromising the relevance, impartiality and methodological soundness of the statistics" (UNSC, 2014).

The topic of big data is gaining momentum in the statistical community. Chief statisticians gathering at the UNSC meetings in 2013 recognized that "big data constitute a source of information that cannot be ignored by official statisticians" and that "official statisticians must organize and take urgent action to exploit the possibilities and harness the challenges effectively" (UNSC, 2014).[30] In view of declining responses to national household and business surveys in a number of countries, big data could provide important sources of more timely and relevant information, thus complementing official statistics on the economy, society and environment. Furthermore, administrative records, which are used widely by official statisticians, could be explored further, thus potentially becoming big data sources as well.

At the UNSC meeting in 2014, the commission reiterated its call for the global statistical community to take action, and supported the proposal to create a global working group on the use of big data for official statistics. The commission requested the group to include the following in its work programme:[31]

- To make an inventory of ongoing activities and concrete examples regarding the use of big data for official statistics at regional, subregional and national levels
- To address the concerns of methodology, standards and norms, human resources, research, training, quality, volatility and, with priority, confidentiality, access to data and legislation related to big data
- To address the issue of obtaining "access at no cost" to big data from the private sector for official statistical purposes, as well as the issue of access to transborder data or access to data on transboundary phenomena
- To develop guidelines to classify the various types of big data sources and approaches
- To develop methodological guidelines related to big data, including guidelines for all the legal aspects
- To formulate an adequate communication strategy for data providers and users on the issue of use of big data for official statistics
- To reach out to other communities, especially those more experienced in IT issues or in the use of open data platforms.

The UN Global Working Group on Big Data for Official Statistics was formally launched in June 2014, under the auspices of the UN Statistics Division. The mandate of the group, of which ITU is a member, includes: provide strategic vision, direction and coordination of a global programme on big data for official statistics; promote practical use of sources of big data for official statistics; provide solutions for methodological, legal and privacy issues; promote capacity building; foster communication and advocacy of the use of big data for policy applications; and build public trust in the use of private-sector big data for official statistics.

ICTs are part of the debate on the data revolution, big data and, more broadly, emerging data issues in the post-2015 development debate. First, the ICT sector in itself represents a new source of data, provided by, for example, Internet and telecommunication companies. Second, the spread and use of ICTs allow public and private entities across all economic sectors to produce, store and analyse huge amounts of data. At the same time, however, monitoring access to and use of ICTs by people, public entities and private enterprises will be essential in order to identify the extent to which stakeholders in the ICT sector can be used as an alternative data source. Without ICTs, no ICT-driven data revolution will take place.

In view of the link between big data and ICTs, work is under way in ITU with a view to contributing to the debate and identifying new ways and means of exploiting the potential of big data. The focus is primarily on the telecommunication/ICT sector as a source of big data, including players such as operators and service providers, in the fixed, mobile and Internet sectors. Delegates attending the eleventh World Telecommunication/ICT Indicators Symposium (WTIS) in Mexico City in December 2014 recommended that ITU should further examine the challenges and opportunities of big data, in particular data coming from ICT companies; that regulatory authorities should explore the development of guidelines on how big data could be produced, exploited and stored; and that national statistical offices, in cooperation with other relevant agencies, should look into the opportunities for big data and address current challenges in terms of big data quality,

Box 1.4: What is a data revolution?

The report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda to the UN Secretary-General, which was published in May 2013, has called for, *inter alia*, a data revolution taking advantage of new technology and improved connectivity: "We also call for a data revolution for sustainable development, with a new international initiative to improve the quality of statistics and information available to people and governments."

This has prompted a "revolution" in the debates taking place in the statistical communities at both the international and national levels on what such a data revolution could entail and how it could be implemented. While no internationally agreed concept has thus far been defined, the following elements seem to be part of a data revolution:[32]

- In view of the ubiquitous availability of communication networks, the use of new information technologies (e.g. mobile technologies) should be leveraged for improving the collection and dissemination of data
- Data should be further disaggregated (by gender, income, age, geography, etc.) to ensure that no one is left out; in this regard, traditional statistical processes should be made more efficient
- Sustained investment in national statistical capacity, both technical and institutional, is essential and needs to receive a major push from the international donor community
- The focus should go beyond data dissemination and also include investment in the development of concepts, measurement frameworks, classifications and standards
- New, non-traditional data sources should be explored and leveraged to complement existing ones and satisfy the demand for data needs in new areas, such as big data, geospatial information and geographical information systems
- Open data policies should be envisaged to ensure accountability and promote transparency
- The role of data, statistics and monitoring for policy-making and decision-making should be increased.

veracity and privacy within the framework of the fundamental principles of official statistics.[33]

The big data approach taken by ITU so far focuses on the following areas and questions:

Standardization:[34]

- Which standards are required to facilitate interoperability and allow technology integration in the big data value chain?
- Which definitions, taxonomies, secure architectures and technology roadmaps need to be developed for big data analytics and technology infrastructures?
- What is the relationship between cloud computing and big data in view of security frameworks?
- Which techniques are needed for data anonymization for aggregated datasets such as mobile-phone records?
- How is big data exploited in different industries; what are the specific challenges faced; and how can these challenges be addressed through international standards?

Regulation:[35]

- What are the key regulatory issues at stake and how can and should big data be regulated?
- How does big data impact on the regulation of privacy, copyright and intellectual property rights (IPR), transparency and digital security issues?

- What is the link between big data and open data (crowdsourcing, cloud computing, etc.)?
- Is there a need to regulate data management and service providers?
- How can market dominance in the area of big data be prevented and the rights of the data owners protected?

ICT data collection and analysis:

- How can big data complement existing ICT statistics to better monitor information-society developments?
- Which type of data from ICT companies are most useful and for which purposes?
- Which new ICT indicators could be produced from big data sources?
- What are the key issues that need to be addressed, and by whom, in terms of collecting and disseminating big data in telecommunications?
- What is the role of national statistical offices and how can big data complement official ICT data?
- How can big data from telecommunications inform not only ICT but broader development policy in real time, leading to prompt and more effective action?

Chapter 5 of this report addresses some of these questions and provides suggestions and recommendations for the way forward.

Endnotes

[1] Refers to countries where fixed-telephone penetration increased by more than 1 per cent in 2014.

[2] See https://gsmaintelligence.com/.

[3] http://www.censusindia.gov.in/2011census/hlo/Data_sheet/India/Communication.pdf.

[4] 4G refers to fourth-generation mobile network or service. It is a mobile-broadband standard offering both mobility and very high bandwidth, such as long-term evolution (LTE) networks (ITU Trends 2014).

[5] Data collection on Europe and North America will follow in 2014.

[6] For a list of IXPs, see for instance http://www.datacentermap.com/ixps.html.

[7] For more details on international submarine fibre-optic links, see TeleGeography's Submarine Cable Map 2014, available at: http://submarine-cable-map-2014.telegeography.com.

[8] For further discussion on progress made towards connecting rural households to the Internet, see Partnership (2014), Chapter on Target 1.

[9] Universal Postal Union (forthcoming 2014). Development strategies for the postal sector: An economic perspective.

[10] See http://www.ifla.org/faife/world-report.

[11] Source: IMF World Economic Outlook Database, April 2014.

[12] Source: The Economist, April 12 2014, "Nigeria's GDP step change".

[13] Telefónica, for instance, reduced its net debt by EUR 4 819 million in 2012 after several years of sustained increases in borrowings. Source: Telefónica Financial Report 2012, p. 18, available at: http://annualreport2012.telefonica.com/pdf/FINANCIERO_2012_ENG.pdf.

[14] For example, the cost of buying a mobile cell tower in Europe and in Africa may not be very different, because only a limited group of large global equipment vendors can deliver it, and equipment is usually traded in USD. On-site set-up expenditure may however differ because of varying labour costs across countries and regions, but that is only a part of the total CAPEX of telecommunication operators.

[15] For instance, the average revenue per user per month for GSM services in India was less than USD 2 in March 2012, almost unchanged from March 2011. Source: TRAI Annual Report 2011-12, p.2, available at: http://www.trai.gov.in/WriteReadData/Miscelleneus/Document/201301150318386780062Annual%20Report%20English%202012.pdf.

[16] Exceptions include China, Russian Federation, Japan and Republic of Korea.

[17] http://www.statisticbrain.com/twitter-statistics/.

[18] Eurostat news release of 16 December 2013 and http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Social_media_-_statistics_on_the_use_by_enterprises.

[19] Data refer mostly to the year 2011.

[20] The UN E-government Development Index is a composite benchmarking indicator based on a direct assessment of the state of national online services, telecommunication infrastructure and human capital in all countries. See http://unpan3.un.org/egovkb/global_reports/index.htm.

[21] See ITU Connect a School, Connect a Community Toolkit of Best Practices and Policy Advice, available at: http://connectaschool.org/itu-module-list.

[22] See Partnership (2014), Chapter on Target 2.

[23] For further information, see http://www.itu.int/wsis/index.html and http://www.broadbandcommission.org.

[24] Information on the post-2015 development agenda process is available at: http://sustainabledevelopment.un.org/index.php?menu=1561.

[25] See http://unstats.un.org/unsd/broaderprogress/progress.html.

[26] "Outcome Document – Open Working Group on Sustainable Development Goals", available at http://sustainabledevelopment.un.org/focussdgs.html.

[27] Available at: http://unctad.org/meetings/en/SessionalDocuments/CSTD_2014_DraftRes_WSIS.pdf.

[28] See ECOSOC Resolutions 2008/3, 2009/7, 2011/16, 2012/5 and 2013/9.

[29] The ITU strategic goals are under discussion and have to be examined and approved by the 2014 ITU Plenipotentiary Conference.

30 E/CN.3/2014/11

31 E/2014/24 and E/CN.3/2014/35 (UNSC Report on the 45th session, 4-7 March 2014).

32 UNSC Friends of the Chair (FOC) Group on Broader Measures of Progress, in its report to UNSC, highlighted a number of elements that should be part of a data revolution.

33 See final report of WTIS-13, available at: http://www.itu.int/en/ITU-D/Statistics/Pages/events/wtis2013/default.aspx.

34 For further information on the work on big data carried out by the ITU Telecommunication Standardization Bureau (TSB), see http://www.itu.int/en/ITU-T/techwatch/Pages/big-data-standards.aspx.

35 A background document on big data that was prepared for GSR-14 is available at http://www.itu.int/en/ITU-D/Conferences/GSR/Pages/gsr2014/default.aspx.

Chapter 2. The ICT Development Index (IDI)

2.1 Introduction to the IDI[1]

The ICT Development Index (IDI) is a composite index combining 11 indicators into one benchmark measure that serves to monitor and compare developments in information and communication technology (ICT) across countries. The IDI was developed by ITU in 2008 and first presented in the 2009 edition of *Measuring the Information Society* (ITU, 2009). It was produced in response to ITU Member States' request to develop an ICT index and publish it regularly. This section briefly describes the main objectives, conceptual framework and methodology of the IDI.

The main objectives of the IDI are to measure:

- the *level* and *evolution over time* of ICT developments in countries and relative to other countries;

- progress in ICT development in both *developed* and *developing countries*: the index should be global and reflect changes taking place in countries at different levels of ICT development;

- the *digital divide*, i.e. differences between countries in terms of their levels of ICT development;

- the *development potential* of ICTs or the extent to which countries can make use of ICTs to enhance growth and development, based on available capabilities and skills.

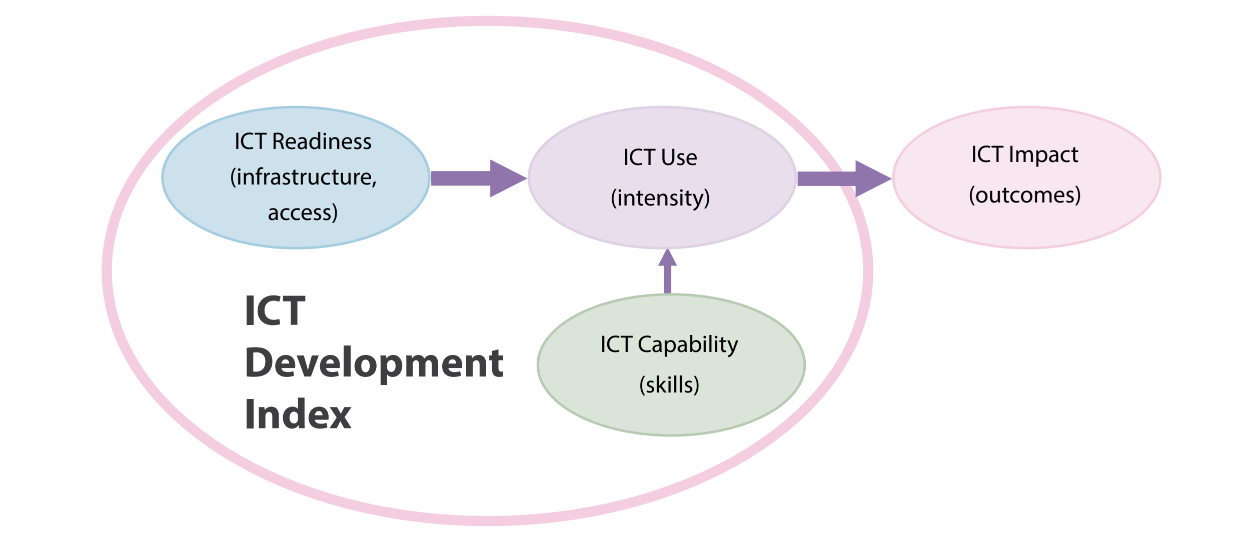
Conceptual framework

The recognition that ICTs can be a development enabler, if applied and used appropriately, is critical to countries that are moving towards information or knowledge-based societies, and is central to the IDI's conceptual framework. The ICT development process, and a country's transformation to becoming an information society, can be depicted using the following three-stage model (Figure 2.1):

- Stage 1: *ICT readiness* (reflecting the level of networked infrastructure and access to ICTs);

- Stage 2: *ICT intensity* (reflecting the level of use of ICTs in the society);

Figure 2.1: Three stages in the evolution towards an information society



Source: ITU.

- Stage 3: *ICT impact* (reflecting the result/outcome of efficient and effective ICT use).

Advancing through these stages depends on a combination of three factors: the availability of ICT infrastructure and access, a high level of ICT usage and the capability to use ICTs effectively. Accordingly, the first two stages listed above correspond to two major components of the IDI: *ICT access* and *ICT use*.

Reaching the final stage, and maximizing the impact of ICTs, crucially depends on the third component of the IDI: *ICT skills*. ICT (and other) skills determine the effective use that is made of ICTs, and are critical to leveraging the full potential of ICTs for socio-economic development. Economic growth and development will remain below potential if economies are not capable of exploiting new technologies and reaping their benefits. Therefore, the IDI includes a measurement of the capability to use ICTs effectively.

A single indicator cannot track progress in all three components (access, usage and skills) of the ICT development process, and it is thus necessary to construct a composite index such as the IDI. The IDI aims to capture the evolution of the information society as it goes through its different stages of development, taking into consideration technology convergence and the emergence of new technologies.

Based on this conceptual framework, the IDI is divided into the following three sub-indices:

- *Access sub-index*: This sub-index captures ICT readiness, and includes five infrastructure and access indicators (fixed-telephone subscriptions, mobile-cellular telephone subscriptions, international Internet bandwidth per Internet user, households with a computer, and households with Internet access).

- *Use sub-index*: This sub-index captures ICT intensity, and includes three ICT intensity and usage indicators (individuals using the Internet, fixed (wired)-broadband subscriptions, and wireless-broadband subscriptions).

- *Skills sub-index*: This sub-index captures ICT capability or skills as indispensable input indicators. It includes three proxy indicators (adult literacy, gross secondary enrolment, and gross tertiary enrolment), and is therefore given less weight in the computation of the IDI compared with the other two sub-indices.[2]

The choice of indicators included in the sub-indices reflects the corresponding stage of transformation to the information society. Therefore, the indicators in each sub-index may change over time to reflect technological developments related to ICTs, and as more and better data become available. For example, what was considered basic infrastructure in the past – such as fixed-telephone lines – is fast becoming less relevant in the light of increasing fixed-mobile substitution. Similarly, broadband is currently considered an advanced technology, characterizing intense Internet use, and is therefore included in stage 2 (as an indicator in the use sub-index). However, in the future it may come to be seen as essential and be moved to stage 1 (as an indicator in the access sub-index), while another, new technology may appear in stage 2.

Methodology

The IDI includes 11 indicators. A detailed definition of each indicator is provided in Annex 1.

The indicators used to calculate the IDI were selected on the basis of the following criteria:

- *The relevance of a particular indicator for contributing to the main objectives and conceptual framework of the IDI*. For example, the selected indicators need to be relevant to both developed and developing countries, and should reflect – as much as possible – the framework's three components described above.

- *Data availability and quality*. Data are required for a large number of countries, as the IDI is a global index. There is relative paucity of ICT-related data, especially on ICT usage, in the majority of developing countries. In particular, the three indicators included in the skills sub-index should be considered as proxies until data directly relating to ICT skills become available for more countries.

- *The results of various statistical analyses*. The statistical associations between various indicators were examined, and principal components analysis (PCA) was used to examine the underlying nature of the data and to explore whether the different dimensions are statistically well-balanced.

While the basic methodology has remained the same since the IDI was first published, minor adjustments are being made each year.

Given the dynamic nature of the ICT sector and related data availability, the indicators included in the IDI and its sub-indices are under regular discussion in ITU, in consultation with experts. Indicator definitions and the IDI methodology are discussed in the ITU Expert Group on Telecommunication/ICT Indicators (EGTI) and the ITU Expert Group on ICT Household Indicators (EGH) (Box 2.1).

The 2014 edition of the IDI reflects updates to indicator definitions and reference values agreed upon during the 2013 meetings of EGTI and EGH.

The definitions of the following core indicators of the Partnership on Measuring ICT for Development included in the IDI were revised at a meeting of EGH held in Brazil in June 2013.[3]

- *Percentage of individuals using the Internet*: The suggested reference period for latest Internet usage was changed from the last twelve months to the last three months. The twelve-month period is still used by some countries, but most already apply the period of three months, considering that Internet usage is now sufficiently frequent that the majority of users will be captured with the shorter time-frame.

Box 2.1: ITU discussion forums on ICT statistics

Much of ITU's work in the area of indicator definitions and statistical methodologies is carried out through its two expert groups: the Expert Group on Telecommunication/ICT Indicators (EGTI) and the Expert Group on ICT Household Indicators (EGH). Created in 2009 and 2012, respectively, these two expert groups revise and review ITU's supply-side and demand-side statistics, and discuss methodological issues and new indicators. Both groups, which are open to all ITU members and to experts in the field of ICT statistics and data collection, work through online discussion forums and annual face-to-face meetings. They periodically report back to the World Telecommunication/ICT Indicators Symposium (WTIS), ITU's main forum on ICT statistics.

In 2011, EGTI opened a discussion item on the IDI on its online forum, and members were invited to provide suggestions on how to improve the IDI methodology. It has been a standing item on the EGTI forum since then. In 2013, EGH revised the Partnership on Measuring ICT for Development core list of ICT indicators, and subsequently updated the ITU Manual for Measuring ICT Access and Use by Households and Individuals (ITU, 2014), which includes the revision of some of the indicators on ICT household access and individual use of ICT included in the IDI.[4]

Interested experts are invited to join the EGTI and/or the EGH discussion forum to share experiences, contribute to the discussions and participate in the decision-making process.

- *Percentage of households with a computer*: The definition of computer was revised to include tablet or similar handheld computers in addition to desktop and laptop computers, so as to reflect the uptake of these devices.

- The definition of *household access* was refined so that, in order for a household to have access to ICT equipment or services, the equipment/service should generally be available for use by all members of the household at any time, regardless of whether it is actually used. ICT equipment may or may not be owned by the household.[5]

Apart from the revisions to indicator definitions presented above, the revised Manual for Measuring ICT Access and Use by Households and Individuals underlines the importance of surveying the entire population, and suggests an age scope of 5 years old and above for individual usage questions. The updated definitions are expected to be adopted by an increasing number of countries in their upcoming household surveys.

The fourth EGTI meeting, held in Mexico City in December 2013, agreed that the reference values for the indicators *international Internet bandwidth per Internet user* and *mobile-cellular subscriptions per 100 inhabitants* would be reviewed. For international Internet bandwidth per Internet user, the methodology used in previous IDI calculations was kept, as there is no limit to the maximum value that could be achieved by a country. The reference value employed for this indicator is used to screen outlier values. There were three economies that were identified as outliers, namely Hong Kong (China), Luxembourg and Malta.

The reference value for mobile-cellular subscriptions was lowered to 120. This value was derived from examining the distribution of countries based on their mobile-cellular subscriptions per 100 inhabitants in 2013. In order to determine the reference value, prepaid and postpaid mobile markets were examined separately, with the former making up the majority of cases. Of all countries included in the IDI, some 57 per cent have more than 80 per cent prepaid subscriptions. For those countries, a mobile-cellular penetration of 120 per cent is the maximum value that was reached by the largest group of countries (23 countries with a mobile-cellular penetration between 110 and 120 per cent), while in countries where postpaid is the predominant mode of subscriptions 120 is also the maximum value achieved. It was therefore concluded that 120 is the ideal value that a country could reach irrespective of the type of mobile subscription that is predominant.

ITU estimates that, by end 2014, the number of mobile-cellular subscriptions will have reached close to 7 billion, which almost corresponds to the figure for the world's population. Multi-SIM ownership is driving up mobile-cellular subscription numbers, which is an issue in prepaid and, to a lesser extent, also in postpaid mobile markets. No fewer than 104 economies of the 166 included in the IDI have passed the 100 per cent mobile-cellular penetration mark.

In order to improve the measure of mobile-cellular uptake, one possibility would be to replace the subscription-based (supply-side) data with data based on national household surveys (demand-side indicators). An indicator such as the *percentage of individuals using a mobile-cellular telephone* (which ITU collects through its household survey questionnaire) might therefore provide a more accurate picture of the actual uptake, use and distribution of mobile-cellular services. While the number of countries that collect this information is increasing steadily, still only 42 countries reported these data to ITU for at least one year between 2011 and 2013. It is therefore too early to substitute the current mobile-cellular subscription data in the IDI with mobile-phone user data. In view of the methodological difficulties in collecting harmonized data on international Internet bandwidth, a review of the definition of the indicator is currently under discussion in EGTI.

The IDI was computed using the same methodology as in the past, applying the following steps (Figure 2.2 and Annex 1):

- *Preparation of the complete data set*. This step includes filling in missing values using various statistical techniques.

- *Normalization of data*. This is necessary in order to transform the values of the IDI indicators into the same unit of measurement. The chosen normalization method was the distance to a reference value (or goalpost). The reference values were either 100 or obtained through a statistical procedure.

- *Rescaling of data*. The data were rescaled on a scale from 0 to 10 in order to compare the values of the indicators and the sub-indices.

- *Weighting of indicators and sub-indices*. The indicator weights were chosen based on the principal components analysis (PCA) results. The access and use sub-indices were given equal weight (40 per cent each). The skills sub-index was given less weight (20 per cent), since it is based on proxy indicators.

This chapter presents the IDI based on data from 2013 in comparison with 2012. It should be noted that IDI 2012 values have changed from those published in the previous edition of this report as a result of:

- *Country data revisions*. As more accurate data become available, countries provide ITU with revised statistics for previous years, which have been taken into consideration. This also allows ITU to identify inconsistencies and revise previous estimates.

- *Revision of the reference value for the indicator mobile-cellular subscriptions per 100 inhabitants*. The change in reference value for this indicator affects the IDI value.

- *Revision of the definitions* of the indicators *percentage of individuals using the Internet* (changing the reference period to the last three months) and *percentage of households with a computer* (updating the definition of computer to include tablet and similar handheld computers – but excluding smartphones).

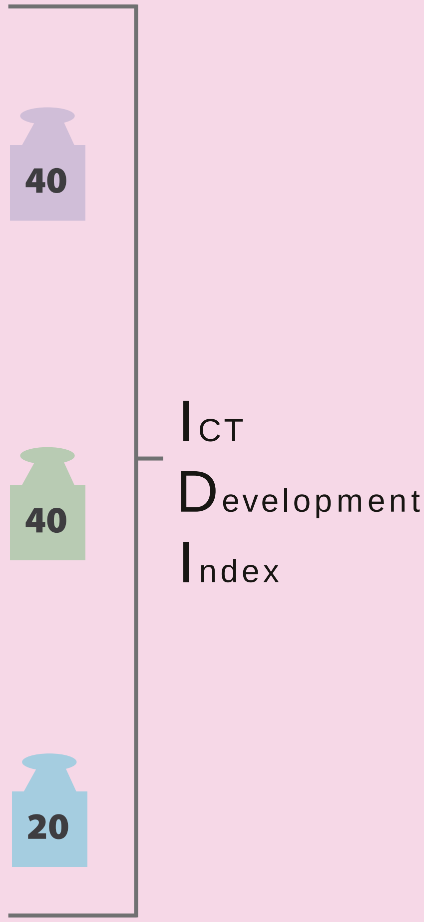
- *Differences among countries included in the IDI*. The calculation of the IDI ranking

Figure 2.2: ICT Development Index: indicators, reference values and weights

ICT access	Reference value	(%)
1. Fixed-telephone subscriptions per 100 inhabitants	60	20
2. Mobile-cellular telephone subscriptions per 100 inhabitants	120	20
3. International Internet bandwidth (bit/s) per Internet user	787'260*	20
4. Percentage of households with a computer	100	20
5. Percentage of households with Internet access	100	20

ICT use	Reference value	(%)
6. Percentage of individuals using the Internet	100	33
7. Fixed (wired)-broadband subscriptions per 100 inhab.itants	60	33
8. Wireless-broadband subscriptions per 100 inhabitants	100	33

ICT skills	Reference value	(%)
9. Adult literacy rate	100	33
10. Secondary gross enrolment ratio	100	33
11. Tertiary gross enrolment ratio	100	33



Note: * This corresponds to a log value of 5.90, which was used in the normalization step.
Source: ITU.

depends on the values of the other countries included. In each new edition, some countries are excluded and others added based on data availability. Overall, this version of the IDI includes 166 countries/economies as compared with 157 in last year's edition.

The remainder of the chapter is structured as follows. Section 2.2 presents the IDI results at the global level. It highlights the group of top performers, as well as the most dynamic countries as reflected by their changes in IDI rank from 2012 to 2013.

Section 2.3 analyses the global digital divide by looking at the IDI results by level of development as well as by groups of countries with different IDI levels.

Section 2.4 explores the relationship between countries' population size and geography and IDI performance.

Section 2.5 highlights the development potential of ICTs, by analysing the relationship between IDI performance and achievement of the Millennium Development Goals (MDGs), as well as progress made towards the World Summit on the Information Society (WSIS) targets.

2.2 Global IDI analysis

The results of the IDI 2013 show that levels of ICT development are very different across the globe. IDI values range from as low as 0.96 in the Central African Republic to a high of 8.86 in Denmark (within a possible (theoretical) range of 0 to 10). The 2013 edition of the IDI includes a total of 166 countries (Table 2.1), with an average IDI value of 4.77, up from 4.60 in 2012. Nearly all countries, at the top as well as at the bottom, increased their IDI values between 2012 and 2013, underlining the continued increase in access to and use of ICTs.

Comparing the access and use sub-indices of the IDI, it is the use sub-index which exhibits the most significant disparities between countries. Use sub-index values have the highest standard deviation (StDev) and coefficient of variation (CV), which measure the variation or dispersion of values from the average. The use sub-index also displays the widest range and the lowest average value (3.19). The minimum value is only 0.03 (in Eritrea). All this points to the fact that extremely low levels of, and important differences in, ICT adoption persist in 2013. However, it is the use sub-index that registered the strongest increase from 2012 to 2013 on average (+0.32), making it the most dynamic sub-index, a trend that is observed even in most of the countries with low IDI values. The access sub-index records the highest average value (5.41), while having a lower range and coefficient of variation than the use sub-index. This suggests that, generally, countries have reached a higher level of ICT readiness, which is yet to translate into intensified usage of ICTs in many countries.

Top IDI countries

The IDI 2013 is headed by Denmark (with an IDI value of 8.86), replacing long-time front runner the Republic of Korea as the country with the highest IDI value in 2013. The Republic of Korea comes in a very close second, with an IDI value of 8.85. The remaining top ten IDI countries are predominantly European (Sweden, Iceland, United Kingdom, Norway, Netherlands, Finland and Luxembourg) and include an additional economy from Asia and the Pacific (Hong Kong, China) (Table 2.2). Differences in IDI value between the top performers are very small. A mere 0.50 difference in IDI value separates first-placed Denmark from tenth-placed Luxembourg. In particular, second-placed Republic of Korea is just 0.01 points behind Denmark. There was very little movement in the top ten of the IDI 2013, Hong Kong (China) being the only new entrant. This reflects the high level of ICT development that the countries at the top have achieved and sustained: all top ten countries have an IDI value of more than eight. Among the top performers, the United Kingdom is the country with the highest increase in rank, moving up from seventh position in 2012 to fifth in 2013.

The top 30 of the IDI 2013 includes mostly countries from Europe, a number of high-income

Table 2.1: IDI values and changes, 2012 and 2013

	IDI 2013						IDI 2012						Change in average value 2012-2013
	Average value*	Min.	Max.	Range	StDev	CV	Average value*	Min.	Max.	Range	StDev	CV	
IDI	4.77	0.96	8.86	7.90	2.22	46.44	4.60	0.93	8.81	7.87	2.19	47.61	0.20
Access sub-index	5.41	1.27	9.46	8.18	2.24	41.39	5.27	1.22	9.40	8.18	2.26	42.93	0.18
Use sub-index	3.19	0.03	8.71	8.68	2.44	76.45	2.90	0.03	8.47	8.44	2.36	81.33	0.32
Skills sub-index	6.66	1.10	9.90	8.80	2.15	32.28	6.66	1.10	9.90	8.80	2.15	32.30	0.01

Note: *Simple averages. StDev= Standard deviation, CV= Coefficient of variation.
Source: ITU.

Table 2.2: ICT Development Index (IDI), 2012 and 2013

Economy	Rank 2013	IDI 2013	Rank 2012	IDI 2012
Denmark	1	8.86	2	8.78
Korea (Rep.)	2	8.85	1	8.81
Sweden	3	8.67	3	8.68
Iceland	4	8.64	4	8.58
United Kingdom	5	8.50	7	8.28
Norway	6	8.39	6	8.35
Netherlands	7	8.38	5	8.36
Finland	8	8.31	8	8.27
Hong Kong, China	9	8.28	11	8.08
Luxembourg	10	8.26	9	8.19
Japan	11	8.22	10	8.15
Australia	12	8.18	12	8.03
Switzerland	13	8.11	13	7.94
United States	14	8.02	14	7.90
Monaco	15	7.93	17	7.72
Singapore	16	7.90	15	7.85
Germany	17	7.90	18	7.72
France	18	7.87	16	7.73
New Zealand	19	7.82	19	7.62
Andorra	20	7.73	24	7.41
Estonia	21	7.68	21	7.54
Macao, China	22	7.66	20	7.59
Canada	23	7.62	25	7.37
Austria	24	7.62	23	7.46
Belgium	25	7.57	26	7.33
Ireland	26	7.57	22	7.48
Bahrain	27	7.40	28	7.22
Spain	28	7.38	29	7.14
Israel	29	7.29	27	7.25
Malta	30	7.25	30	7.08
Slovenia	31	7.13	31	6.96
United Arab Emirates	32	7.03	46	6.27
Latvia	33	7.03	33	6.84
Qatar	34	7.01	42	6.46
Barbados	35	6.95	32	6.87
Italy	36	6.94	36	6.66
Croatia	37	6.90	34	6.70
Belarus	38	6.89	43	6.45
Greece	39	6.85	35	6.70
Lithuania	40	6.74	40	6.50
Czech Republic	41	6.72	38	6.57
Russian Federation	42	6.70	41	6.48
Portugal	43	6.67	39	6.57
Poland	44	6.60	37	6.63
Slovakia	45	6.58	45	6.30
Hungary	46	6.52	44	6.35
Saudi Arabia	47	6.36	50	6.01
Uruguay	48	6.32	51	5.92
Bulgaria	49	6.31	47	6.12
Serbia	50	6.24	49	6.07
Cyprus	51	6.11	48	6.09
Oman	52	6.10	61	5.43
Kazakhstan	53	6.08	53	5.80
St. Kitts and Nevis	54	6.01	52	5.89
Costa Rica	55	5.92	55	5.64
Chile	56	5.92	54	5.68
Antigua & Barbuda	57	5.89	59	5.49
Romania	58	5.83	58	5.52
Argentina	59	5.80	56	5.58
TFYR Macedonia	60	5.77	62	5.42
Moldova	61	5.72	60	5.44
Lebanon	62	5.71	64	5.32
Montenegro	63	5.67	57	5.52
Azerbaijan	64	5.65	65	5.22
Brazil	65	5.50	67	5.16
Brunei Darussalam	66	5.43	63	5.36
Trinidad & Tobago	67	5.29	70	4.99
Turkey	68	5.29	68	5.12
Bosnia and Herzegovina	69	5.23	74	4.89
Mauritius	70	5.22	72	4.96
Malaysia	71	5.20	66	5.18
St. Vincent and the Gren.	72	5.17	69	5.04
Ukraine	73	5.15	71	4.97
Armenia	74	5.08	73	4.89
Seychelles	75	4.97	76	4.70
Grenada	76	4.96	75	4.83
Colombia	77	4.95	80	4.61
Georgia	78	4.86	83	4.48
St. Lucia	79	4.81	79	4.66
Venezuela	80	4.81	78	4.68
Thailand	81	4.76	91	4.09
Panama	82	4.75	77	4.69
Dominica	83	4.72	81	4.58

Economy	Rank 2013	IDI 2013	Rank 2012	IDI 2012
Albania	84	4.72	85	4.42
Maldives	85	4.71	82	4.50
China	86	4.64	86	4.39
Jordan	87	4.62	84	4.48
Ecuador	88	4.56	88	4.28
Egypt	89	4.45	87	4.28
South Africa	90	4.42	89	4.19
Fiji	91	4.40	103	3.90
Mongolia	92	4.32	90	4.19
Cape Verde	93	4.30	104	3.86
Iran (I.R.)	94	4.29	97	4.02
Mexico	95	4.29	94	4.07
Morocco	96	4.27	92	4.09
Jamaica	97	4.26	98	4.01
Suriname	98	4.26	93	4.08
Tunisia	99	4.23	96	4.07
Palestine	100	4.16	95	4.07
Viet Nam	101	4.09	99	3.94
Dominican Rep.	102	4.06	105	3.78
Philippines	103	4.02	102	3.91
Botswana	104	4.01	100	3.94
Peru	105	4.00	101	3.92
Indonesia	106	3.83	106	3.70
Bolivia	107	3.78	109	3.52
Kyrgyzstan	108	3.78	107	3.69
Paraguay	109	3.71	108	3.56
El Salvador	110	3.61	110	3.47
Guyana	111	3.48	111	3.44
Syria	112	3.46	112	3.39
Ghana	113	3.46	115	3.29
Algeria	114	3.42	114	3.30
Uzbekistan	115	3.40	116	3.27
Sri Lanka	116	3.36	113	3.31
Namibia	117	3.24	118	3.08
Guatemala	118	3.20	117	3.11
Honduras	119	3.18	119	3.01
Nicaragua	120	2.96	120	2.78
Zimbabwe	121	2.89	123	2.68
Sudan	122	2.88	121	2.69
Bhutan	123	2.85	126	2.58
Kenya	124	2.79	124	2.62
Cuba	125	2.77	122	2.69
Gabon	126	2.66	125	2.61
Cambodia	127	2.61	127	2.54
Swaziland	128	2.60	128	2.43
India	129	2.53	129	2.42
Senegal	130	2.46	133	2.20
Nepal	131	2.37	134	2.20
Lesotho	132	2.36	131	2.22
Nigeria	133	2.35	135	2.14
Lao P.D.R.	134	2.35	130	2.25
Gambia	135	2.31	136	2.12
Solomon Islands	136	2.29	132	2.22
Congo (Rep.)	137	2.24	137	2.09
Yemen	138	2.18	138	2.07
Angola	139	2.17	139	2.06
Cameroon	140	2.10	142	1.98
Djibouti	141	2.08	140	2.01
Pakistan	142	2.05	141	2.01
Mali	143	2.04	147	1.86
Zambia	144	2.02	143	1.97
Bangladesh	145	1.97	146	1.90
Uganda	146	1.94	144	1.90
Mauritania	147	1.91	145	1.90
Rwanda	148	1.86	151	1.74
Benin	149	1.84	149	1.75
Myanmar	150	1.82	148	1.75
Côte d'Ivoire	151	1.80	150	1.74
Tanzania	152	1.76	152	1.72
Liberia	153	1.70	154	1.57
Guinea-Bissau	154	1.67	153	1.60
Afghanistan	155	1.67	155	1.57
Burkina Faso	156	1.56	160	1.35
Congo (Dem. Rep.)	157	1.56	157	1.47
Malawi	158	1.52	156	1.50
Mozambique	159	1.52	159	1.40
Madagascar	160	1.42	158	1.43
Guinea	161	1.42	161	1.31
Ethiopia	162	1.31	162	1.24
Eritrea	163	1.20	163	1.18
Chad	164	1.11	164	1.09
Niger	165	1.03	165	0.97
Central African Rep.	166	0.96	166	0.93

Source: ITU.

Table 2.3: IDI access sub-index, 2012 and 2013

Economy	Rank 2013	Access 2013	Rank 2012	Access 2012
Luxembourg	1	9.46	1	9.40
Switzerland	2	9.36	3	9.30
Iceland	3	9.28	2	9.31
Hong Kong, China	4	9.24	4	9.16
Germany	5	9.19	7	8.99
United Kingdom	6	9.18	5	9.10
Malta	7	8.98	10	8.88
Korea (Rep.)	8	8.94	9	8.91
Sweden	9	8.93	6	9.02
Netherlands	10	8.93	8	8.95
Denmark	11	8.80	11	8.83
France	12	8.65	13	8.52
Singapore	13	8.61	12	8.53
Japan	14	8.40	15	8.26
Norway	15	8.36	14	8.33
Israel	16	8.31	18	8.21
Monaco	17	8.31	20	8.19
Austria	18	8.28	16	8.23
Belgium	19	8.26	19	8.20
Ireland	20	8.24	17	8.22
Australia	21	8.23	21	8.14
Qatar	22	8.09	28	7.80
Canada	23	8.01	22	8.04
Slovenia	24	7.91	26	7.84
Macao, China	25	7.88	24	7.90
Barbados	26	7.86	25	7.89
Andorra	27	7.84	30	7.69
Estonia	28	7.82	33	7.67
Finland	29	7.80	27	7.80
New Zealand	30	7.79	23	7.94
United States	31	7.78	29	7.75
Bahrain	32	7.72	34	7.64
Spain	33	7.70	31	7.69
Portugal	34	7.67	32	7.68
United Arab Emirates	35	7.67	38	7.39
Italy	36	7.62	36	7.44
Greece	37	7.53	35	7.48
Belarus	38	7.39	42	7.12
Hungary	39	7.32	41	7.15
Croatia	40	7.31	37	7.43
St. Kitts and Nevis	41	7.29	40	7.22
Latvia	42	7.29	44	7.06
Czech Republic	43	7.26	46	7.02
Russian Federation	44	7.25	48	7.01
Brunei Darussalam	45	7.24	39	7.22
Serbia	46	7.22	43	7.09
Oman	47	7.12	63	6.28
Uruguay	48	7.05	52	6.80
Poland	49	7.04	49	7.00
Saudi Arabia	50	7.04	53	6.80
Slovakia	51	7.03	50	6.93
Antigua & Barbuda	52	7.02	45	7.02
Lithuania	53	7.00	51	6.91
Cyprus	54	6.93	47	7.02
St. Vincent and the Gren.	55	6.85	56	6.72
Kazakhstan	56	6.84	54	6.73
Bulgaria	57	6.77	55	6.72
Montenegro	58	6.74	57	6.66
Romania	59	6.62	60	6.40
Argentina	60	6.62	61	6.38
Malaysia	61	6.58	58	6.59
Moldova	62	6.56	64	6.26
TFYR Macedonia	63	6.55	59	6.40
Seychelles	64	6.46	69	6.06
Lebanon	65	6.45	62	6.29
Trinidad & Tobago	66	6.36	65	6.18
Chile	67	6.35	66	6.17
Mauritius	68	6.32	68	6.07
Costa Rica	69	6.27	67	6.11
Ukraine	70	6.16	71	6.01
Brazil	71	6.14	70	6.03
Grenada	72	6.07	72	5.96
Azerbaijan	73	6.07	73	5.83
Maldives	74	6.05	76	5.75
Georgia	75	5.99	78	5.61
Dominica	76	5.86	74	5.79
Turkey	77	5.83	77	5.66
St. Lucia	78	5.68	75	5.77
Armenia	79	5.64	79	5.55
Morocco	80	5.63	82	5.39
Bosnia and Herzegovina	81	5.63	83	5.31
Iran (I.R.)	82	5.53	85	5.11
Panama	83	5.53	80	5.46

Economy	Rank 2013	Access 2013	Rank 2012	Access 2012
Jordan	84	5.47	81	5.43
Colombia	85	5.44	86	5.08
Suriname	86	5.38	87	5.05
Venezuela	87	5.36	84	5.23
Ecuador	88	5.16	89	4.89
China	89	5.10	91	4.78
Egypt	90	5.09	88	4.99
Thailand	91	4.88	92	4.71
South Africa	92	4.82	94	4.66
Mexico	93	4.80	97	4.54
Mongolia	94	4.79	90	4.78
Palestine	95	4.77	93	4.67
El Salvador	96	4.76	95	4.61
Albania	97	4.62	101	4.42
Fiji	98	4.60	100	4.44
Jamaica	99	4.58	99	4.46
Tunisia	100	4.56	96	4.56
Cape Verde	101	4.55	108	4.19
Peru	102	4.54	102	4.41
Syria	103	4.50	98	4.47
Paraguay	104	4.49	104	4.36
Viet Nam	105	4.48	103	4.39
Ghana	106	4.47	106	4.30
Algeria	107	4.46	107	4.22
Guatemala	108	4.35	105	4.32
Indonesia	109	4.32	109	4.19
Philippines	110	4.30	110	4.17
Dominican Rep.	111	4.15	114	3.97
Bolivia	112	4.11	116	3.85
Botswana	113	4.06	113	3.99
Kyrgyzstan	114	4.05	111	4.01
Guyana	115	4.04	112	3.99
Nicaragua	116	3.98	119	3.63
Honduras	117	3.94	120	3.62
Namibia	118	3.93	121	3.59
Gabon	119	3.88	117	3.81
Sri Lanka	120	3.85	115	3.86
Cambodia	121	3.73	118	3.70
Mali	122	3.55	126	3.13
Sudan	123	3.46	122	3.24
Gambia	124	3.39	131	2.95
Kenya	125	3.29	124	3.14
Senegal	126	3.23	128	3.03
Côte d'Ivoire	127	3.19	127	3.07
Bhutan	128	3.18	125	3.13
Zimbabwe	129	3.12	129	2.99
Lao P.D.R.	130	3.10	132	2.93
Mauritania	131	3.08	123	3.15
India	132	3.05	133	2.89
Pakistan	133	3.03	130	2.95
Lesotho	134	3.02	134	2.82
Swaziland	135	3.02	135	2.78
Uzbekistan	136	2.95	136	2.78
Benin	137	2.94	137	2.72
Cameroon	138	2.75	140	2.53
Nepal	139	2.70	143	2.44
Zambia	140	2.68	138	2.63
Yemen	141	2.66	142	2.49
Congo (Rep.)	142	2.65	139	2.55
Bangladesh	143	2.57	144	2.42
Nigeria	144	2.53	148	2.29
Angola	145	2.52	141	2.51
Guinea-Bissau	146	2.50	146	2.33
Burkina Faso	147	2.46	150	2.27
Solomon Islands	148	2.45	145	2.36
Afghanistan	149	2.44	151	2.23
Rwanda	150	2.43	152	2.23
Tanzania	151	2.37	147	2.31
Djibouti	152	2.36	149	2.28
Liberia	153	2.36	154	2.14
Guinea	154	2.28	155	2.00
Mozambique	155	2.21	156	1.93
Uganda	156	2.18	153	2.19
Niger	157	1.95	158	1.81
Malawi	158	1.89	157	1.90
Ethiopia	159	1.87	159	1.73
Cuba	160	1.87	162	1.66
Myanmar	161	1.85	161	1.72
Congo (Dem. Rep.)	162	1.72	164	1.54
Madagascar	163	1.68	160	1.72
Chad	164	1.65	163	1.61
Central African Rep.	165	1.32	165	1.28
Eritrea	166	1.27	166	1.22

Source: ITU.

Table 2.4: IDI use sub-index, 2012 and 2013

Economy	Rank 2013	Use 2013	Rank 2012	Use 2012
Denmark	1	8.71	1	8.47
Sweden	2	8.29	2	8.22
Korea (Rep.)	3	8.26	3	8.20
Finland	4	8.09	4	8.01
Norway	5	8.07	5	7.99
United Kingdom	6	7.88	9	7.39
Japan	7	7.80	6	7.78
Luxembourg	8	7.66	7	7.54
Iceland	9	7.65	8	7.47
United States	10	7.50	11	7.21
Australia	11	7.48	12	7.19
Netherlands	12	7.43	10	7.34
Hong Kong, China	13	7.36	14	6.93
Monaco	14	7.29	15	6.89
Singapore	15	7.19	13	7.14
New Zealand	16	7.10	20	6.47
Bahrain	17	7.06	17	6.70
Macao, China	18	7.01	16	6.81
Andorra	19	6.79	22	6.12
Estonia	20	6.77	18	6.58
Switzerland	21	6.75	21	6.38
France	22	6.74	19	6.52
Canada	23	6.63	24	5.97
United Arab Emirates	24	6.51	36	4.90
Austria	25	6.28	26	5.93
Ireland	26	6.24	23	6.02
Germany	27	6.21	25	5.97
Belgium	28	6.18	28	5.63
Spain	29	6.04	30	5.46
Qatar	30	5.95	38	4.86
Latvia	31	5.91	27	5.67
Croatia	32	5.62	34	5.00
Israel	33	5.53	29	5.53
Malta	34	5.48	31	5.16
Italy	35	5.38	37	4.87
Lithuania	36	5.29	40	4.79
Slovakia	37	5.28	41	4.69
Czech Republic	38	5.22	32	5.09
Slovenia	39	5.21	39	4.85
Barbados	40	5.20	35	4.95
Belarus	41	4.99	48	4.16
Russian Federation	42	4.97	42	4.69
Poland	43	4.94	33	5.06
Saudi Arabia	44	4.77	49	4.13
Bulgaria	45	4.77	45	4.34
Hungary	46	4.67	43	4.42
Oman	47	4.65	54	3.81
Greece	48	4.65	46	4.32
Portugal	49	4.61	44	4.35
Uruguay	50	4.56	53	3.81
Costa Rica	51	4.48	52	3.92
Azerbaijan	52	4.40	58	3.55
Serbia	53	4.34	50	4.05
Cyprus	54	4.34	47	4.22
Lebanon	55	4.33	59	3.52
Kazakhstan	56	4.33	55	3.73
TFYR Macedonia	57	4.22	60	3.51
St. Kitts and Nevis	58	4.21	51	3.99
Chile	59	4.08	56	3.67
Brazil	60	4.01	62	3.25
Antigua & Barbuda	61	3.99	68	2.99
Moldova	62	3.94	57	3.56
Romania	63	3.87	61	3.33
Bosnia and Herzegovina	64	3.71	63	3.17
Trinidad & Tobago	65	3.60	67	3.03
Argentina	66	3.42	65	3.10
Montenegro	67	3.37	66	3.08
Albania	68	3.26	71	2.73
Turkey	69	3.24	69	2.98
Malaysia	70	3.16	64	3.10
Thailand	71	3.12	105	1.61
Fiji	72	3.08	96	1.99
Colombia	73	3.07	75	2.58
Botswana	74	3.03	70	2.93
St. Lucia	75	3.02	78	2.55
Armenia	76	3.02	73	2.66
China	77	2.99	72	2.68
Mauritius	78	2.97	76	2.57
Cape Verde	79	2.90	91	2.15
Egypt	80	2.87	77	2.55
Dominica	81	2.79	80	2.50
South Africa	82	2.75	83	2.32
Seychelles	83	2.74	81	2.47

Economy	Rank 2013	Use 2013	Rank 2012	Use 2012
Panama	84	2.70	74	2.61
Brunei Darussalam	85	2.68	79	2.53
Maldives	86	2.66	82	2.43
Dominican Rep.	87	2.65	92	2.13
Jamaica	88	2.62	94	2.13
Tunisia	89	2.59	88	2.18
Georgia	90	2.58	95	2.03
Ecuador	91	2.58	87	2.18
Morocco	92	2.50	84	2.30
Viet Nam	93	2.50	86	2.21
St. Vincent and the Gren.	94	2.47	85	2.27
Mexico	95	2.45	90	2.17
Venezuela	96	2.36	89	2.17
Philippines	97	2.28	93	2.13
Jordan	98	2.22	100	1.90
Grenada	99	2.14	99	1.91
Ukraine	100	2.11	101	1.80
Uzbekistan	101	2.09	98	1.94
Suriname	102	2.06	97	1.96
Zimbabwe	103	1.92	108	1.53
Bolivia	104	1.86	109	1.46
Palestine	105	1.84	102	1.72
Indonesia	106	1.80	104	1.61
Ghana	107	1.76	107	1.55
Peru	108	1.69	103	1.62
Mongolia	109	1.69	112	1.37
Namibia	110	1.67	106	1.60
Bhutan	111	1.67	119	1.06
Sudan	112	1.65	111	1.39
Nigeria	113	1.60	113	1.32
Kyrgyzstan	114	1.59	110	1.41
Paraguay	115	1.50	115	1.24
Iran (I.R.)	116	1.44	116	1.18
Kenya	117	1.41	117	1.15
Guyana	118	1.36	114	1.31
El Salvador	119	1.27	118	1.07
Senegal	120	1.25	126	0.80
Sri Lanka	121	1.10	120	0.96
Syria	122	1.07	122	0.93
Angola	123	1.06	124	0.82
Honduras	124	1.03	121	0.93
Swaziland	125	0.99	125	0.82
Guatemala	126	0.96	127	0.78
Nepal	127	0.92	128	0.77
Cuba	128	0.86	123	0.86
Uganda	129	0.83	129	0.74
Yemen	130	0.73	131	0.63
Algeria	131	0.73	130	0.67
Nicaragua	132	0.68	132	0.58
India	133	0.68	133	0.57
Congo (Rep.)	134	0.57	145	0.27
Lesotho	135	0.55	138	0.41
Solomon Islands	136	0.55	135	0.47
Cambodia	137	0.55	139	0.40
Zambia	138	0.54	134	0.48
Gambia	139	0.51	136	0.46
Lao P.D.R.	140	0.50	137	0.43
Rwanda	141	0.49	141	0.38
Burkina Faso	142	0.45	155	0.13
Djibouti	143	0.43	142	0.37
Pakistan	144	0.42	140	0.38
Mauritania	145	0.40	143	0.31
Gabon	146	0.35	144	0.30
Malawi	147	0.31	146	0.26
Congo (Dem. Rep.)	148	0.30	147	0.25
Cameroon	149	0.28	153	0.19
Bangladesh	150	0.27	148	0.23
Tanzania	151	0.24	150	0.21
Mozambique	152	0.24	149	0.23
Ethiopia	153	0.24	151	0.20
Afghanistan	154	0.24	152	0.20
Liberia	155	0.21	156	0.13
Benin	156	0.18	154	0.16
Côte d'Ivoire	157	0.16	157	0.13
Mali	158	0.14	159	0.10
Central African Rep.	159	0.12	158	0.10
Guinea-Bissau	160	0.10	160	0.10
Madagascar	161	0.09	161	0.08
Niger	162	0.09	163	0.07
Myanmar	163	0.08	165	0.04
Chad	164	0.08	162	0.08
Guinea	165	0.05	164	0.05
Eritrea	166	0.03	166	0.03

Source: ITU.

Table 2.5: IDI skills sub-index, 2012 and 2013

Economy	Rank 2013	Skills 2013	Rank 2012	Skills 2012
Greece	1	9.90	1	9.90
Korea (Rep.)	2	9.81	2	9.81
Finland	3	9.75	3	9.75
Belarus	4	9.69	4	9.69
United States	5	9.56	5	9.56
Australia	6	9.50	6	9.50
Slovenia	7	9.43	7	9.43
Andorra	8	9.41	8	9.41
Spain	9	9.41	9	9.41
Iceland	10	9.32	10	9.32
New Zealand	11	9.28	11	9.28
Denmark	12	9.28	12	9.28
Ukraine	13	9.23	13	9.23
Estonia	14	9.21	14	9.21
Netherlands	15	9.20	15	9.20
Lithuania	16	9.12	16	9.12
Norway	17	9.09	17	9.09
Russian Federation	18	9.03	18	9.03
Poland	19	9.01	19	9.01
Belgium	20	8.99	20	8.99
Austria	21	8.96	21	8.96
Argentina	22	8.94	22	8.94
Ireland	23	8.92	23	8.92
Sweden	24	8.90	24	8.90
Canada	25	8.85	25	8.85
Israel	26	8.78	26	8.78
Portugal	27	8.77	27	8.77
Latvia	28	8.75	28	8.75
Chile	29	8.72	29	8.72
Italy	30	8.71	30	8.71
Germany	31	8.68	31	8.68
Japan	32	8.67	32	8.67
Barbados	33	8.65	33	8.65
Czech Republic	34	8.65	34	8.65
Mongolia	35	8.64	35	8.64
Croatia	36	8.63	36	8.63
Hungary	37	8.62	37	8.62
Venezuela	38	8.62	38	8.62
France	39	8.57	39	8.57
Macao, China	40	8.53	40	8.53
Bulgaria	41	8.46	41	8.46
Monaco	42	8.45	42	8.45
United Kingdom	43	8.41	43	8.41
Cuba	44	8.41	44	8.41
Uruguay	45	8.39	45	8.39
Grenada	46	8.38	46	8.38
Switzerland	47	8.34	47	8.34
Turkey	48	8.34	48	8.34
Slovakia	49	8.28	49	8.28
Hong Kong, China	50	8.24	50	8.24
Saudi Arabia	51	8.17	51	8.17
Romania	52	8.17	52	8.17
Montenegro	53	8.15	53	8.15
Costa Rica	54	8.13	54	8.13
Serbia	55	8.07	55	8.07
Kazakhstan	56	8.06	56	8.06
Armenia	57	8.04	57	8.04
Cyprus	58	7.99	58	7.99
Singapore	59	7.90	59	7.90
Albania	60	7.82	61	7.82
Thailand	61	7.81	60	7.82
Jordan	62	7.74	62	7.74
Colombia	63	7.71	63	7.71
Kyrgyzstan	64	7.62	64	7.62
Palestinian Authority	65	7.59	65	7.59
Moldova	66	7.57	66	7.57
Peru	67	7.53	67	7.53
Iran (I.R.)	68	7.52	68	7.52
Mauritius	69	7.51	69	7.51
Bosnia and Herzegovina	70	7.50	70	7.50
Bahrain	71	7.44	71	7.44
Antigua & Barbuda	72	7.41	72	7.41
Azerbaijan	73	7.33	73	7.33
Panama	74	7.32	74	7.32
Malta	75	7.32	75	7.32
Brunei Darussalam	76	7.32	76	7.32
Ecuador	77	7.29	78	7.24
TFYR Macedonia	78	7.29	77	7.29
St. Vincent and the Gr.	79	7.23	79	7.23
Brazil	80	7.22	80	7.22
Georgia	81	7.14	81	7.14
Luxembourg	82	7.08	82	7.08
St. Kitts and Nevis	83	7.03	83	7.03
China	84	7.02	84	7.02
Lebanon	85	6.99	85	6.99
South Africa	86	6.98	86	6.98
Bolivia	87	6.97	87	6.97
Mexico	88	6.96	88	6.96
Qatar	89	6.95	89	6.95
Oman	90	6.95	90	6.95
Uzbekistan	91	6.94	91	6.94
Philippines	92	6.93	92	6.93
Sri Lanka	93	6.91	93	6.91
Jamaica	94	6.89	94	6.89
Indonesia	95	6.89	95	6.89
Tunisia	96	6.86	96	6.86
United Arab Emirates	97	6.79	97	6.79
Algeria	98	6.72	98	6.72
Dominican Rep.	99	6.69	100	6.67
St. Lucia	100	6.67	99	6.67
Fiji	101	6.64	101	6.64
Cape Verde	102	6.62	102	6.62
Paraguay	103	6.59	103	6.59
Guyana	104	6.59	104	6.59
Malaysia	105	6.54	105	6.54
Trinidad & Tobago	106	6.54	106	6.54
Viet Nam	107	6.50	107	6.50
Seychelles	108	6.44	108	6.44
Suriname	109	6.40	109	6.40
Egypt	110	6.33	110	6.33
Dominica	111	6.31	111	6.31
Syria	112	6.17	112	6.17
Maldives	113	6.12	113	6.12
El Salvador	114	6.00	114	6.00
Honduras	115	5.96	115	5.96
Botswana	116	5.86	116	5.86
Nicaragua	117	5.49	117	5.49
Solomon Islands	118	5.44	118	5.44
Guatemala	119	5.37	119	5.37
Myanmar	120	5.22	120	5.22
India	121	5.20	121	5.20
Morocco	122	5.07	122	5.07
Namibia	123	5.02	123	5.02
Swaziland	124	4.96	124	4.96
Djibouti	125	4.84	127	4.76
Ghana	126	4.82	128	4.72
Gabon	127	4.82	125	4.82
Congo	128	4.77	126	4.77
Lesotho	129	4.66	129	4.66
Nepal	130	4.61	130	4.58
Kenya	131	4.54	131	4.54
Bhutan	132	4.54	132	4.54
Lao P.D.R.	133	4.53	133	4.53
Cambodia	134	4.49	134	4.49
Cameroon	135	4.45	135	4.45
Zimbabwe	136	4.36	136	4.36
Bangladesh	137	4.18	137	4.18
Sudan	138	4.18	138	4.18
Yemen	139	4.11	139	4.11
Gambia	140	3.76	140	3.76
Congo (Dem. Rep.)	141	3.76	141	3.76
Uganda	142	3.66	142	3.66
Angola	143	3.65	143	3.65
Zambia	144	3.64	144	3.64
Madagascar	145	3.55	145	3.55
Tanzania	146	3.55	146	3.55
Nigeria	147	3.51	147	3.51
Rwanda	148	3.49	148	3.49
Eritrea	149	3.41	149	3.41
Pakistan	150	3.36	150	3.36
Senegal	151	3.35	151	3.35
Liberia	152	3.32	152	3.32
Malawi	153	3.21	153	3.21
Guinea-Bissau	154	3.12	154	3.12
Afghanistan	155	2.98	155	2.98
Benin	156	2.96	156	2.96
Mali	157	2.85	157	2.85
Mozambique	158	2.71	158	2.71
Mauritania	159	2.58	159	2.58
Guinea	160	2.44	160	2.44
Ethiopia	161	2.35	161	2.35
Côte d'Ivoire	162	2.32	162	2.32
Chad	163	2.08	163	2.08
Burkina Faso	164	1.97	164	1.97
Central African Rep.	165	1.91	165	1.91
Niger	166	1.10	166	1.10

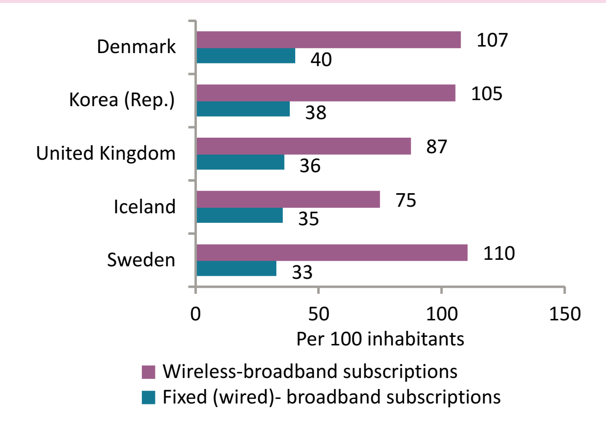
Source: ITU.

countries from Asia and the Pacific (Japan, Australia, Singapore, New Zealand and Macao (China)), the United States and Canada, as well as Bahrain, the only country from the Arab States region. All countries included in the top 30 have an IDI value of more than seven.

The top performers of the IDI 2013 share a number of common characteristics that help to explain their high levels of ICT access and use. All have highly liberalized and competitive ICT markets that are at the forefront of innovation, and people that have the skills to make use of ICTs. Furthermore, there is a strong link between income levels and IDI values, with all of the top ten countries being high-income economies (see section 2.3).[6] The following section looks at the performance of the top ten countries of IDI 2013.

Denmark ranks at the top of the IDI 2013, replacing the Republic of Korea, the front-runner in 2012, 2011 and 2010. This small, technology-driven country with a highly skilled population has been quick to adapt to new technologies. According to data from the European Union (EU), 85 per cent of Danes have some level of computer skills (compared to the EU average of 67 per cent) and 42 per cent of the population have "high" computer skills.[7] In 2010, the digital economy accounted for more than 5.8 per cent of GDP, and it continues to grow. Having regard to the general economic downturn, Denmark's government sees ICTs as a major driver for growth, innovation and economic development (Government of Denmark, 2012).

Chart 2.1: Fixed (wired)-broadband and wireless-broadband subscriptions per 100 inhabitants, top five IDI countries, 2013



Source: ITU World Telecommunication/ICT Indicators database.

The country has a highly developed ICT infrastructure, as reflected by an access sub-index value of 8.84. Household ICT connectivity is extremely high, among the highest in Europe, with 93 per cent of households with Internet access and households with a computer by end 2013. Next-generation access, providing speeds of at least 30 Mbit/s, was available to 73 per cent of households, well above the EU average of 54 per cent. Denmark's national target even exceeds the EU's Digital Agenda objective of 100 per cent coverage of households with broadband speeds of 30 Mbit/s, and aims to provide access of at least 100 Mbit/s to all households in the country by 2020 (Erhvervs- og Vækstministeriet, 2012). The Danish Internet service provider (ISP) TDC is making investments to provide access to ultra-fast speeds for over half a million households.[9] Denmark enjoys abundant international Internet bandwidth of more than 260 000 bit/s per Internet user in 2013.

Denmark tops the IDI use sub-index. The country's broadband market is particularly well advanced. At 107 per cent, it has one of the highest wireless-broadband penetration rates in the world, and an equally impressive fixed-broadband penetration rate of 40 per cent. In both indicators – although Sweden has a slightly higher wireless-broadband penetration – Denmark surpasses the other top five IDI countries (see Chart 2.1). In terms of LTE population coverage, Denmark stands way above the regional (and world) average, with 65 per cent of the population covered.[9] In January 2013, Denmark auctioned the 800 MHz spectrum in order to meet the increasing demand generated by wireless-broadband services. There is an obligation for the licensees to ensure that by 2015 users in areas with the lowest speeds will have access to mobile broadband at speeds of at least 10 Mbit/s.[10]

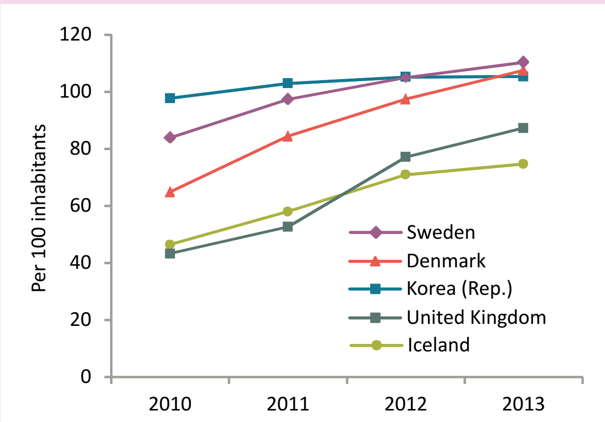
The **Republic of Korea** ranks second in the IDI 2013. The former leader in the IDI 2012, 2011 and 2010 continues to attain very high values on all the sub-indices of the IDI. It ranks in third position in the use sub-index, and eighth position in the access sub-index. Fixed-broadband and wireless-broadband penetration stand at top levels at 38 per cent and 105 per cent, respectively (see Chart 2.1). The Republic of Korea was the first country to offer 3G services commercially in 2002, and LTE was first offered in 2011. Two years after commercializing the first LTE network, leading operator SK Telecom reported that it passed the 10 million LTE subscriber mark in April 2013; this represents 37 per cent of its total mobile subscriber base. Full coverage having being achieved (by April 2012, LTE was available nationwide), the wireless-broadband market is showing signs of saturation, with little growth over the past years. From 2012 to 2013, there was only a minimal increase in penetration, from 105.1 per cent in 2012 to 105.3 in 2013 (see Chart 2.2). The focus of operators and policy-makers has shifted from access to wireless services to improving quality and speed. In July 2013, SK Telecom launched the "world`s first LTE-Advanced Network", with speeds of up to 150 Mbit/s. In 2014, the Vice-President of the European Commission for the Digital Agenda and the Republic of Korea's Minister of Science, ICT and Future Planning signed an agreement to work towards a global definition of 5G and to cooperate in 5G research.[11]

In regard to fixed broadband, there is still more potential for growth, and from 2012 to 2013 more fixed-broadband than wireless-broadband subscriptions were added (around 485 000 fixed-broadband compared with 370 000 wireless-broadband subscriptions). Data also show that the Republic of Korea achieves the highest advertised fixed-broadband speeds, with all subscriptions providing at least 10 Mbit/s. This compares with 75 per cent of fixed-broadband subscriptions at advertised speeds of at least 10 Mbit/s in Denmark, and 66 per cent in Sweden.

At 98 per cent, the Republic of Korea has the highest proportion of households with Internet access worldwide. A somewhat lower proportion of 81 per cent of households have a computer. International Internet bandwidth is relatively low, compared to other top IDI countries, at just over one Tbit/s in 2012. There is however a sizeable domestic demand for data driven by the high volume of local content, and domestic Internet bandwidth was ten times higher compared with international bandwidth.

Third-placed **Sweden** records an IDI value of 8.67 in 2013. Like the remaining EU countries in the top ten, namely **United Kingdom** (fifth), **Netherlands** (seventh), **Finland** (eighth) and **Luxembourg** (tenth), Sweden has an excellent ICT infrastructure, a skilled population and high levels of ICT usage. **Iceland** (fourth) and **Norway** (sixth) are not EU members, but cooperate with the EU in the field of ICTs, for example through the Digital Agenda for Europe initiative, and share many common characteristics. All these countries have an IDI value of more than eight and were already among the top ten countries of the IDI 2012. Luxembourg ranks first in the IDI access sub-index with its state-of-the-art infrastructure and large amounts of international

Chart 2.2: Wireless-broadband subscriptions per 100 inhabitants, top five IDI countries, 2010-2013



Source: ITU World Telecommunication/ICT Indicators database.

Internet bandwidth. The United Kingdom stands out as the most dynamic of the top ten IDI countries. It improved its IDI value from 8.28 in 2012 to 8.51 in 2013.

The growth in wireless-broadband subscriptions is having a major impact on ICT markets, and European top performers have been at the forefront of this trend. Wireless-broadband penetration exceeds 60 per cent in these countries, with Finland and Sweden having more than one subscription per inhabitant. Norway has a wireless-broadband penetration of 89 per cent, followed by the United Kingdom (87 per cent), Luxembourg (80.5 per cent), Iceland (75 per cent) and the Netherlands (62 per cent). By early 2013, virtually all (96 per cent) of EU citizens were covered by a 3G signal and 26 per cent of the population was covered by an LTE network.[12] Denmark, Sweden and Finland are the countries with the highest LTE coverage in the European region (European Commission, 2014a).

The European Commission is partnering with the Republic of Korea to work towards a definition of 5G. Furthermore, it launched a public-private partnership on 5G (5G PPP) in late 2013 that aims to "deliver solutions, architectures, technologies and standards for the ubiquitous next-generation communication infrastructures of the coming decade". A total of EUR 3 billion have been pledged over the next seven years, with EUR 700 million coming from the European Commission and the private sector set to match this investment by up to five times.[13]

European top performers stand out when it comes to ICT access at home. Data from the EU confirm that household access is highly correlated with regular use of the Internet, which underlines the importance of household access.[14] All European countries included in the top ten of the IDI have a household ICT penetration (both households with a computer and households with Internet) of at least 88 per cent. Iceland and the Netherlands display the highest levels of households with a computer, at 97 and 95 per cent, respectively.[15] In Luxembourg and Norway, 94 per cent of households have Internet access, followed by Sweden (93 per cent), Finland (89 per cent) and the United Kingdom (88 per cent). With household ICT connectivity reaching saturation levels in the top performing countries, the attention of policy-makers has shifted to improving quality of access. The European Commission's Digital Agenda for Europe acknowledges the importance of connecting homes with fast and ultra-fast broadband and sets ambitious targets to have 50 per cent of homes subscribed to ultra-fast broadband (at least 100 Mbit/s) and coverage of all households by broadband speeds of at least 30 Mbit/s by 2020.[16]

In the United Kingdom, the country that saw the highest increase in rank within the top ten, the availability of superfast broadband[17] of at least 30 Mbit/s is increasing steadily. In 2013, superfast networks covered 73 per cent of premises, up from 65 per cent in 2012. Most of this can be put down to the incumbent operator's fibre-to-the-cabinet' (FTTC) network, which passed 57 per cent of premises. The UK government aims to achieve coverage of at least 90 per cent in 2016, and has made GBP 530 million of funding available for the roll-out of networks in sparsely populated underserved areas. With this continued increase in availability, uptake of superfast fixed broadband is increasing: as of June 2013, 22 per cent of broadband connections were superfast, compared to 10 per cent in 2012 (Ofcom, 2013).

The countries with the highest fixed-broadband penetration in the world are all from Europe, and have attained a penetration of at least 30 per cent by end 2013. Sweden has the fastest fixed broadband in Europe, with a quarter of all fixed-broadband subscriptions reaching (advertised) speeds of 100 Mbit/s and above. Data from the European Commission's Digital Agenda underline the competitiveness of the European fixed-broadband market: in January 2013, the market shares of the incumbent operators compared to new entrants were 42 per cent to 58 per cent on average.[18]

High levels of Internet connectivity at home and the availability of mobile Internet translate into high degrees of Internet usage in the IDI's top ten countries. The Nordic countries stand out with the highest percentage of Internet users globally. In Iceland, 97 per cent of the (in-scope) population is using the Internet and 95 per cent of Norwegians, Swedes and Danes are online.[19]

The availability of international Internet bandwidth is critical for ICT development. All IDI top performers benefit from the abundant availability of international Internet bandwidth. Bandwidth is highest (per Internet user) in such hubs as Luxembourg, Iceland, Sweden and the United Kingdom.

Hong Kong (China) made its entry into the top ten of the IDI 2013, up from 11th position in 2012. The economy ranks in ninth position, with an IDI value of 8.28. Hong Kong (China) is particularly strong on the access sub-index of the IDI, in which it ranks fourth. As an international financial hub, the regulator has made the provision of international Internet bandwidth a policy priority in order to secure reliable and low-latency Internet connectivity (see MIS 2013). In 2013, international Internet bandwidth stood at 1.7 million bit/s per Internet user, which is the second highest value after Luxembourg's.

Hong Kong (China) has the second highest fixed-telephone penetration globally, at 63 per cent, and relatively high levels of household ICT connectivity, at 80 per cent of households with Internet and 82 per cent with a computer. Both fixed-broadband (31 per cent) and wireless-broadband (95 per cent) penetration are very high in Hong Kong (China).

Dynamic IDI countries

Even though most countries do not dramatically increase in IDI rank within a year, there are some significant and remarkable developments. Table 2.6 lists the so-called "dynamic" countries, i.e. those that show the highest increases in IDI, access sub-index and/or use sub-index rank from 2012 to 2013. The IDI's use sub-index is much more dynamic than the access sub-index. The indicator that has seen the largest increases from 2012 to 2013, spurring most of the IDI rank increase, is wireless-broadband subscriptions. Globally, the number of mobile-broadband subscriptions[20] grew by 24 per cent from 2012 to 2013. Developing countries showed the strongest growth, at 37 per cent. The dynamic countries on the IDI's use sub-index far exceed average growth rates.

Table 2.6: Most dynamic countries - changes between IDI 2013 and 2012

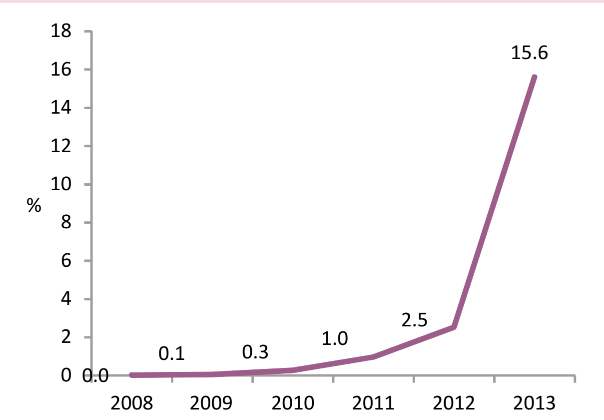
Change in IDI ranking			Change in access ranking			Change in use ranking		
IDI rank 2013	Country	IDI rank change	Access rank 2013	Country	Access rank change	Use rank 2013	Country	Use rank change
32	United Arab Emirates	14	47	Oman	16	71	Thailand	34
91	Fiji	12	101	Cape Verde	7	72	Fiji	24
93	Cape Verde	11	124	Gambia	7	142	Burkina Faso	13
81	Thailand	10	22	Qatar	6	79	Cape Verde	12
52	Oman	9	28	Estonia	5	24	United Arab Emirates	12
34	Qatar	8	64	Seychelles	5	134	Congo (Rep.)	11
38	Belarus	5	97	Albania	4*	111	Bhutan	8
69	Bosnia and Herzegovina	5	38	Belarus	4*	30	Qatar	8
78	Georgia	5	112	Bolivia	4*	61	Antigua & Barbuda	7**

Note: * In the access sub-index, Mali, Mexico, Nepal, Nigeria, the Russian Federation and Uruguay also went up four places between 2012 and 2013. **In the use sub-index, Belarus and Oman also went up seven places.
Source: ITU.

High increases in wireless-broadband subscriptions can be seen in countries that were late adopters of 3G technology. For instance, mobile-broadband services were only commercialized in mid-2013 in Burkina Faso,[21] which is among the most dynamic countries on the use sub-index (+13 ranks). Other most dynamic countries have seen a significant increase in the number of wireless-broadband subscriptions from 2012 to 2013 due to a rise in competition (i.e. the awarding of further licences), lower prices (see Chapter 4) and increased uptake by users. In the Republic of the Congo, 3G was launched in late 2011 by Airtel Congo, and the entry of a second operator (MTN Congo) is reflected in a significant increase in penetration rate from 2 per cent in 2012 to 11 per cent in 2013 (Agence de Régulation des Postes et des Communications Electroniques, 2011), placing the country among the most dynamic on the use sub-index. In the United Arab Emirates, increases in IDI rank (+14) are also mostly due to the expansion of wireless-broadband penetration, which doubled from 45 per cent (in 2012) to 90 per cent (in 2013).

The following section looks at selected most dynamic countries in more detail. Figure 2.3 shows spider charts of the most dynamic countries, which illustrate normalized values and changes between 2012 and 2013 for each one of the 11 indicators included in the IDI.

Chart 2.3: Wireless-broadband penetration, Bhutan, 2008-2013



Source: ITU World Telecommunication/ICT Indicators database.

Cape Verde moved up eleven ranks in the IDI 2013, to 93rd position. Significant improvements were made in both the access (+7 ranks) and use (+12 ranks) sub-indices. Cape Verde's progress in terms of ICT development can be linked to the country's connection to the West Africa Cable System (WACS)[22] in mid-2012, which added significant amounts of international Internet bandwidth and increased international Internet bandwidth per Internet user from around 6 000 bit/s in 2012 to close to 12 000 bit/s per user in 2013. The submarine cable system spans Africa's west coast, from South Africa to Côte d'Ivoire, and connects it to Europe. It provides international Internet connectivity, which is of particular importance for enabling an island state such as Cape Verde to join the information society. Further progress in the access sub-index is attributable to the increase in mobile-cellular penetration, which in 2013 exceeded 100 per cent of inhabitants. Increases in the use sub-index are mostly driven by the impressive growth in the number of wireless-broadband subscriptions. From 2012 to 2013, the number of subscriptions almost doubled, reaching a penetration of 43 per cent. Mobile-broadband services were only launched in December 2011, and by 2013 operator CVMovel had expanded 3G services to all the islands of the archipelago.[23]

Bhutan is one of the most dynamic countries in the use sub-index, moving up eight places. The country ranks 123rd in the IDI 2013. While mobile-broadband services were introduced as early as 2008 by state-owned operator Bhutan Telecom (under its B-Mobile brand), major developments took place in 2013 that helped to boost penetration from only 2.5 per cent in 2012 to 16 per cent in 2013 (see Chart 2.3). Bhutan Telecom expanded its 3G services, which had been limited to the nation's capital Thimphu, to 15 out of 20 districts in Bhutan. Some USD 10.9 million were allocated to optimize and expand the operator's mobile network.[24] Furthermore, Bhutan Telecom launched its high-speed 4G services in Thimphu in late 2013. The launch of mobile-broadband services by the country's only private-owned operator Tashi Cell in late 2013 has helped to increase coverage and competition in the market, which in turn has led to higher adoption rates.[25] Apart from those major improvements in access to wireless-broadband services, uptake is also ascribed to the growing popularity of social media and increased availability of smartphones.[26]

Bolivia is among the most dynamic countries on the access sub-index (+4 ranks), and also shows good progress in the generally more dynamic use sub-index (+5 ranks). The country reported an important increase in international Internet bandwidth. International Internet bandwidth per Internet user[27] almost doubled between 2012 and 2013, climbing to 9 000 bit/s per user. While this is still one of the lowest absolute figures in the Americas region (only Cuba has a lower bandwidth per Internet user), it indicates that good progress in being made in improving connectivity in the country. Bolivia has seen an important increase in wireless-broadband penetration, from 7 per cent in 2012 to 14 per cent in 2013.

In order to increase rural connectivity, landlocked Bolivia launched its first telecommunication satellite "Tupac Katari" in late 2013.[28] ENTEL – Bolivia's state-owned operator – is contracting capacity from Tupac Katari, which it will use to connect more rural areas of the country through the establishment of 3 000 telecentres by end 2014.[29]

Georgia made remarkable progress in terms of ICT development over the period 2012-2013. The country moved up five places to 78th position in the IDI 2013. Georgia has a well-developed ICT infrastructure, reflected in its relatively high ranking on the access sub-index (75th position), a liberalized and competitive ICT market, and a high amount of international Internet bandwidth (close to 82 000 bit/s per Internet user).[30] It is well-connected to its neighbouring countries in the CIS region and to Europe through two Black Sea fibre-optic cables and terrestrial links.[31] This laid the foundation for the country's improvement in the IDI 2013, with strong growth across the different indicators (USAID, 2013). In particular, the country was very successful in connecting households to the Internet – penetration increased from 27 per cent in 2012 to 35 per cent in 2013 – and in increasing the proportion of households with a computer – from 33 per cent in 2012 to close to 40 per cent in 2013. At the same time, both wireless- and fixed-broadband penetration went up significantly. Wireless-broadband penetration almost doubled, to 17 per cent, while fixed-broadband penetration reached 10 per cent by end 2013, up from 9 per cent in 2012.

Qatar moved up eight places to 34th position in the IDI 2013. Progress was strong in both the access (+6 ranks) and use (+8 ranks) sub-indices of the IDI. In particular, Qatar exhibits some of the highest increases in household ICT connectivity. The proportion of households with Internet stands at 96 per cent and the proportion of households with a computer at 97 per cent in 2013 (see Chart 2.4). A report by ICTQatar shows that Qataris are not only almost all very well-connected at home, but have a multitude of devices at their disposal. Over the period 2012-2013, the ownership of devices such as mobile phones and laptops increased significantly within the country's mainstream population.[32]

The report also highlights discrepancies in ICT connectivity between Qataris and westerners, on the one hand, and transient labourers, on the other. While virtually all Qataris and westerners have an Internet connection at home, penetration stands at 85 per cent for the overall population. Smartphone penetration is also much lower among transient labourers (24 per cent). Therefore, "increasing the penetration of newer devices such as smartphones and tablets, particularly in specific demographic segments like the transient labour population" is one of the policy recommendations brought forward by the report (ICTQatar 2014).

Figure 2.3: IDI spider charts, selected dynamic countries, 2012 and 2013

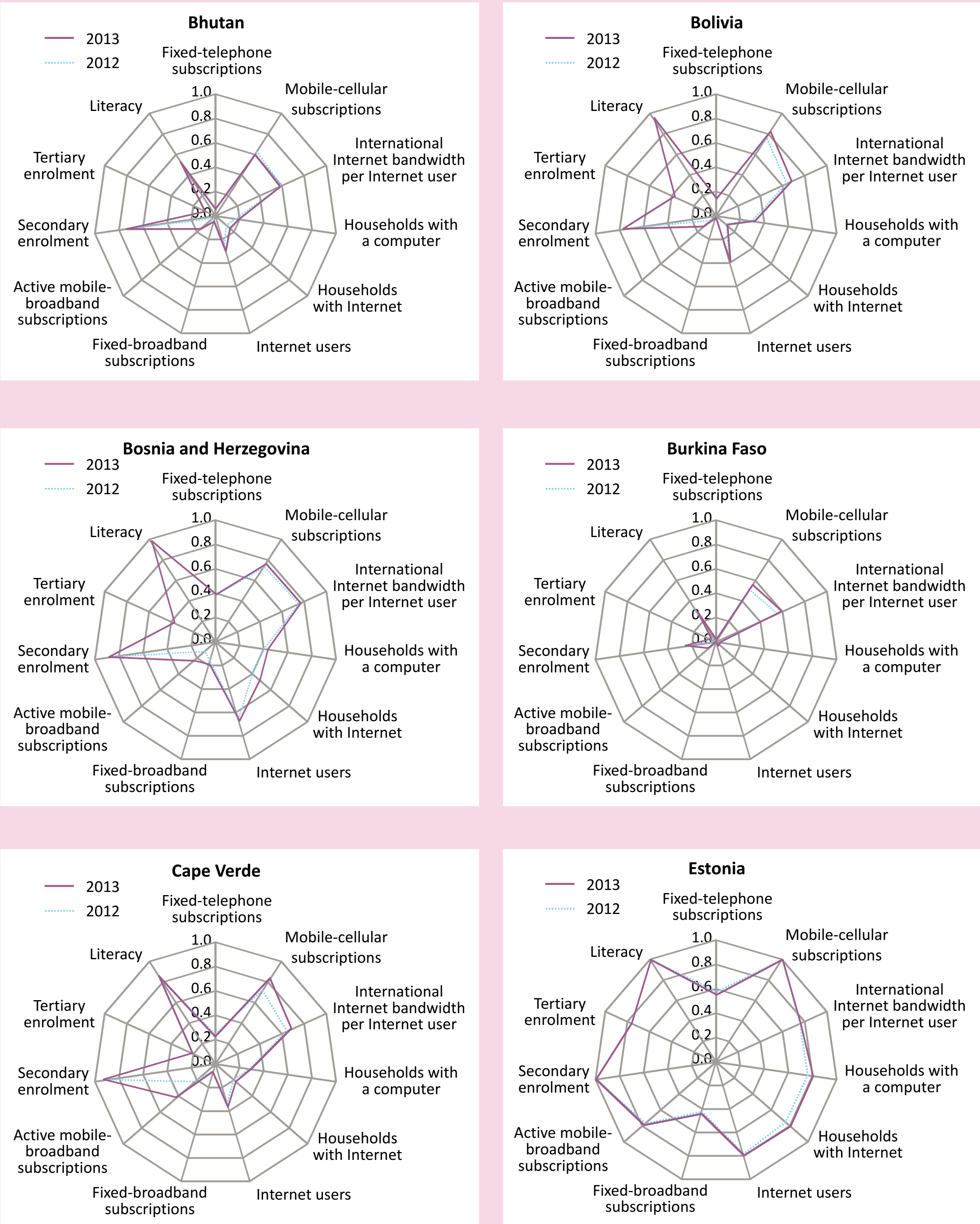


Figure 2.3: IDI spider charts, selected dynamic countries, 2012 and 2013 (continued)

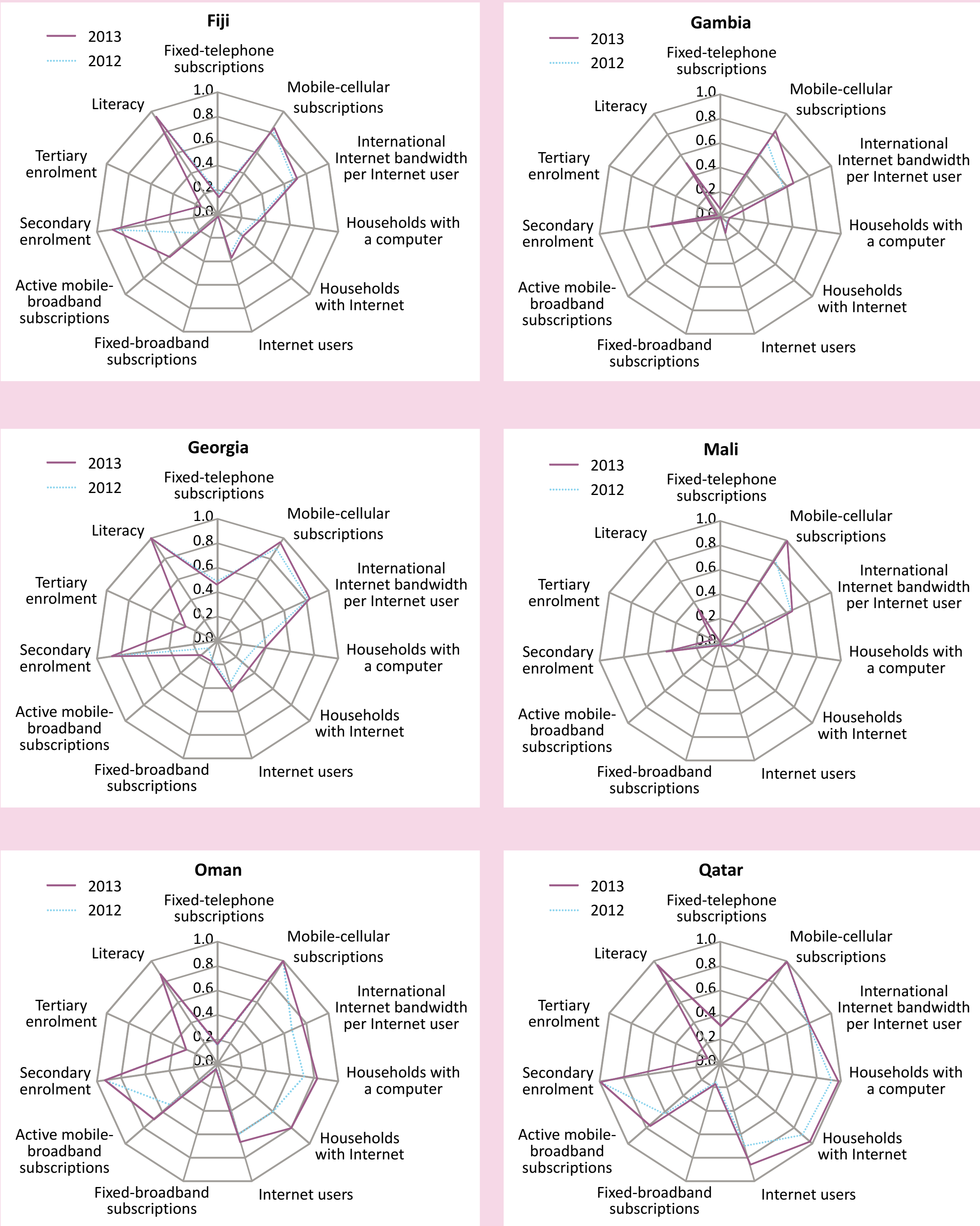
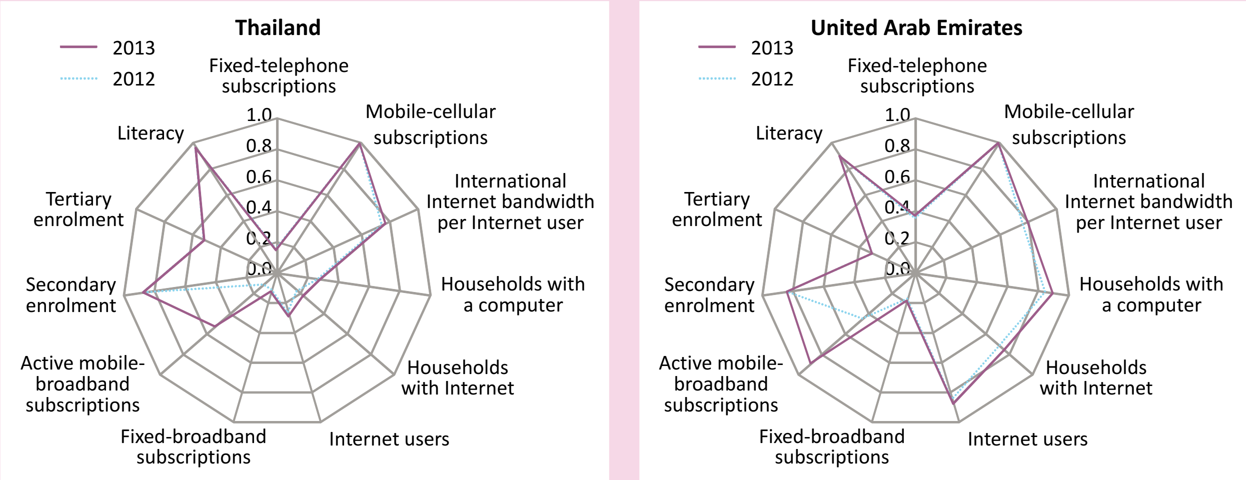


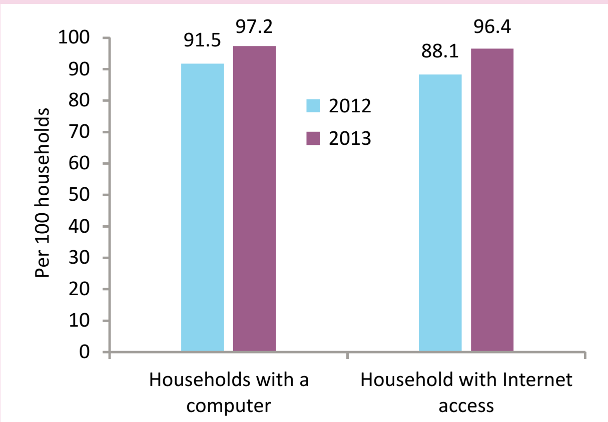
Figure 2.3: IDI spider charts, selected dynamic countries, 2012 and 2013 (continued)



Note: These charts show normalized values of the indicators included in the IDI.
Source: ITU.

Looking to the future, the country released its first national broadband plan in 2013, which prioritizes broadband infrastructure development to make services faster, more affordable and more secure. One of the core projects of the Qatar National Broadband Network is the deployment of a fibre-optic network infrastructure.[33]

Chart 2.4: Proportion of households with a computer and proportion of households with Internet access, 2012-2013, Qatar



Source: ITU World Telecommunication/ICT Indicators database.

Thailand is one of the most dynamic countries on the use sub-index (+34 ranks), which led to an improvement in its overall IDI ranking from 91st in 2012 to 81st in 2013. In particular, the country's wireless market proved to be extremely vibrant during the period 2012-2013: more than 7 million new mobile-cellular subscriptions and close to 28 million new wireless-broadband subscriptions were added within one year. Penetration rates stand at 138 per cent for mobile-cellular and 52 per cent for wireless-broadband services by end 2013. This is one of the highest wireless-broadband penetration rates in Asia and the Pacific, only surpassed by the region's high-income economies. The launch of 3G was much anticipated in Thailand, following the long delay in the auctioning of 3G licences. In December 2012, licences were finally awarded to three Thai operators,[34] providing high-speed mobile Internet connectivity to users. The rapid uptake of mobile-broadband services was spurred by heated competition among operators offering subsidized smartphones and promotions on mobile data plans.[35] During 2013, operators further extended their wireless infrastructure and services throughout Thailand, and are planning to provide further network updates.[36]

2.3 Monitoring the digital divide: Developed, developing and least connected countries

Tracking the global digital divide is one of the main objectives of the IDI. The digital divide can be understood as the difference in ICT development, within and between countries, regions or other groupings. In this section, IDI performance will be analysed and compared with regard to levels of (economic) development, and on the basis of IDI groupings (based on IDI values). The digital divide is measured by looking at differences in IDI values between these different groups. As a composite index that consolidates several ICT indicators into one single value, the IDI is an especially useful tool for comparing differences in ICT developments. Based on the 2013 and 2012 data presented in this chapter, the current (2013) global divide is measured and differences from 2012 are identified. This also serves to determine whether the digital divide has been increasing or decreasing over the past year. Special emphasis is placed on those countries that lie at the bottom of the IDI – the so-called "least connected countries" (LCCs).

The analysis of IDI values by level of development reveals a significant disparity between developed and developing countries. Developed countries reach an average IDI value of 7.20, while the developing-country average is almost half that, at 3.84. The increase in average value between 2012 and 2013 was almost the same in developing (+0.17) and developed countries (+0.18) when measured in absolute terms (Table 2.7). This indicates that developing countries – as a group – are not progressing enough in terms of ICT development to close the gap. Given their lower starting point, however, the average IDI value of developing countries increased twice as much (+4.9 per cent) compared to developed countries (+2.5 per cent) when measured in relative terms (Chart 2.5).

The range of IDI values is much higher in developing countries, a group that includes both top IDI countries such as the Republic of Korea as well as LCCs. The measures of dispersion and variation (StDev, CV and range) continue to increase, indicating that disparities within the group of developing countries are rising. Furthermore, the minimum value is not only significantly lower in developing than in developed countries, but has also increased much less. While both developed and developing countries exhibit progress in ICT development, the analysis shows that developing countries are not advancing enough to catch up with developed countries and that within the group of developing countries disparities in ICT development continue to rise.

The most important increases in the access-sub index occurred in developing countries, with an average value increase almost three times that of developed countries. At the same time, the difference in average value (between developed and developing countries) is lower than in the use

Table 2.7: IDI by level of development, 2012-2013

	IDI 2012						IDI 2013						Change in average value 2012-2013
	Average value*	Min.	Max.	Range	StDev	CV	Average value*	Min.	Max.	Range	StDev	CV	
World	4.60	0.93	8.81	7.87	2.19	47.61	4.77	0.96	8.86	7.90	2.22	46.44	0.17
Developed	7.03	4.42	8.78	4.35	1.08	15.39	7.20	4.72	8.86	4.14	1.03	14.24	0.18
Developing	3.67	0.93	8.81	7.87	1.75	47.61	3.84	0.96	8.85	7.89	1.80	46.93	0.17

Note: *Simple averages. StDev= Standard deviation, CV= Coefficient of variation.
Source: ITU.

Chart 2.5: IDI by level of development

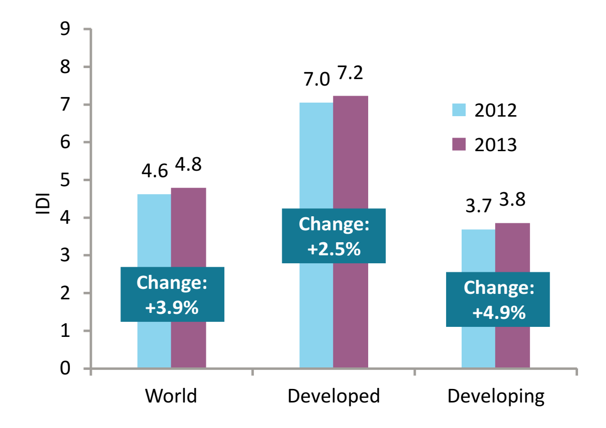


Chart 2.6: IDI access sub-index by level of development

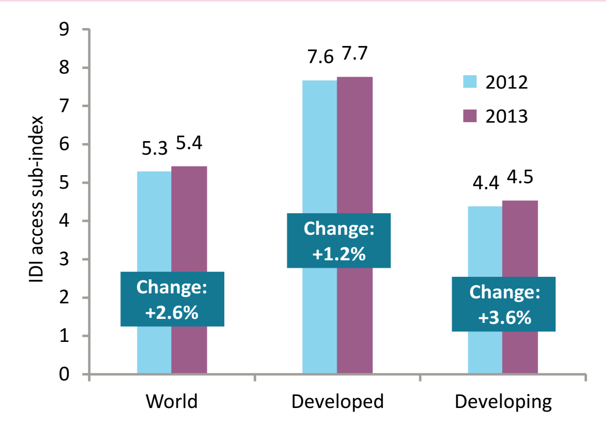
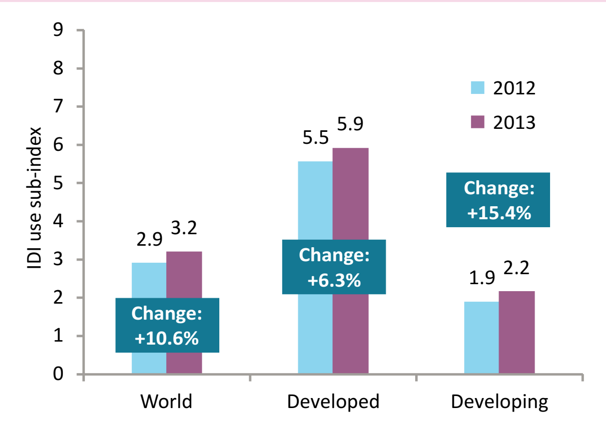


Chart 2.7: IDI use sub-index by level of development



Note: Simple averages.
Source: ITU.

sub-index, showing that developing countries are improving their ICT infrastructure, which is a prerequisite for intensifying ICT usage (Chart 2.6). However, progress was slower than in the other sub-indices of the IDI. Fixed-telephone penetration is decreasing in developing and developed countries. Mobile-cellular subscription growth rates are slowing down, indicating that mobile-cellular penetration is nearing saturation, including in developing countries. The growth in household ICT connectivity is much higher in developing countries, where around three-quarters of households are not yet connected to the Internet, leaving ample room for growth. This also holds true for international Internet bandwidth, which is still at very low levels in many developing countries.

The use sub-index is the most dynamic, showing the biggest improvements, particularly in developing countries. However, the average value is lowest in this sub-index, affording the biggest potential for growth. The difference in average value between developed and developing countries is also highest in the use sub-index, which underlines that significant differences exist with regard to the intensity of ICT usage (Chart 2.7). In many developing countries, the availability and uptake of wireless-broadband and fixed-broadband services in particular is still relatively limited. On average, fixed-broadband penetration reached 6 per cent in developing countries by end 2013, compared with 27 per cent in developed countries. While many developing countries saw important increases in their use sub-index value following the introduction of 3G services in 2012/2013, there were still a few countries that had not launched services by end 2013. In 2014, close to 4.3 billion people, most of them living in the developing world, were not using the Internet. Bringing those people online is an important task in developing countries.

Differences are smallest between developed and developing countries in the skills sub-index. However, in the absence of alternative measurements, this sub-index includes three proxy indicators that do not measure actual

Table 2.8: IDI by groups, 2012 and 2013

Group	IDI 2012							IDI 2013					
	Number of countries	Average value*	Min.	Max.	Range	StDev	CV	Average value*	Min.	Max.	Range	StDev	CV
High	42	7.52	6.46	8.81	2.35	0.70	9.27	7.69	6.70	8.86	2.16	0.63	8.22
Upper	40	5.38	4.50	6.45	1.95	0.56	10.38	5.63	4.75	6.67	1.91	0.58	10.26
Medium	42	3.69	2.62	4.48	1.86	0.54	14.61	3.88	2.79	4.72	1.93	0.58	14.97
Low	42	1.83	0.93	2.61	1.68	0.44	23.77	1.93	0.96	2.77	1.81	0.46	24.03
Total	**166**	**4.60**	**0.93**	**8.81**	**7.87**	**2.19**	**47.61**	**4.77**	**0.96**	**8.86**	**7.90**	**2.22**	**46.44**

Note: *Simple averages. StDev= Standard deviation, CV= Coefficient of variation.
Source: ITU.

ICT skills, but rather levels of literacy and school enrolment. Data change very little over time and advances in skills do not show immediate effects.

One shortcoming of grouping countries into only two categories (developed and developing) is that these categories include countries at very different stages of ICT development. The developing-country group, which is defined on the basis of the United Nations classification, also includes ICT champions such as the Republic of Korea, Hong Kong (China) and Singapore. Therefore, for the purpose of comparing levels of ICT development and analysing the digital divide, countries are also grouped on the basis of their IDI value. To this end, four groups/quartiles were formed, reflecting four different levels of ICT development: high, upper, medium and low (Table 2.8).

The average value of each of the IDI groups increased between 2012 and 2013, showing that countries with high and low IDI values are progressing in terms of ICT development. The upper IDI group shows the highest increase in average value between 2012 and 2013. The range and measures of disparity in IDI values decreased the most for the high IDI group. This indicates that countries with higher IDI values are making good progress in terms of ICT development and are moving at a similar pace. In the low IDI group, the range is not only the smallest – reflecting the extremely low levels of ICT development reached across this group – but is also widening between 2012 and 2013. The countries in the low group of the IDI have been coined "least connected countries" (LCCs) since the 2012 edition of the MIS Report (ITU, 2012) (Box 2.2).

2.4 Geography, population size, economic development and the IDI

Introduction

The purpose of this section is to look in more detail at some of the underlying factors that can have an influence on ICT development and IDI performance across countries. The 166 countries included in the IDI 2013 all have very different socio-economic characteristics that may be reflected in their different levels of ICT development. Countries differ significantly in terms of land area, size of the economy, population or geographic location. Indeed, adverse geography is often cited by economists to explain why some countries are doing better than others in terms of economic development.[37] Jeffrey Sachs argues that "geography matters because it affects

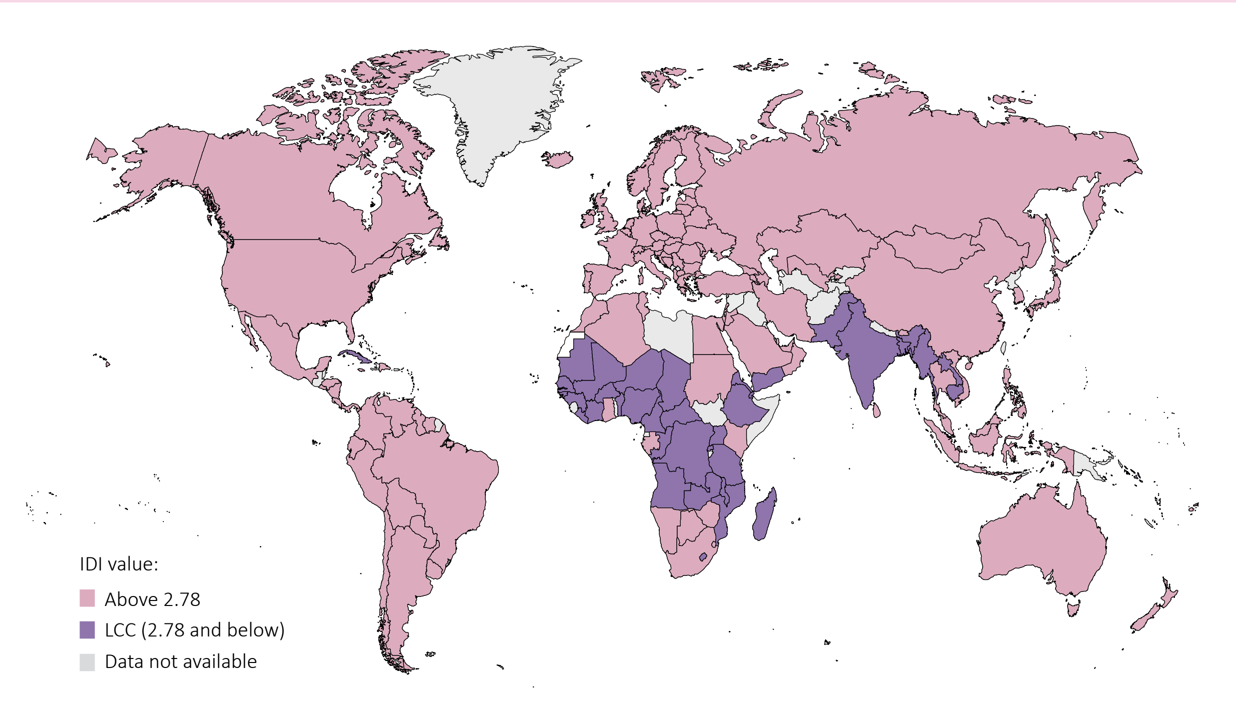
Box 2.2: The world's least connected countries (LCCs)

The world's least connected countries (LCCs) are the group of 42 countries that fall within the low IDI group, based on a categorization that divides the 166 countries included in the IDI into four groups (high, upper, medium, and low) (Figure Box 2.2). In the LCCs, levels of ICT access and usage are extremely low.

International Internet bandwidth availability is very limited, thus constraining Internet connectivity and driving up ICT prices, which in turn hampers usage of ICTs. Few households (less than 5 per cent in the majority of LCCs) are connected to the Internet and fewer than 5 per cent of households in all LCCs have a computer. Basic voice services are more widely available, although LCCs like Eritrea (6 per cent), Myanmar (13 per cent) and Cuba (18 per cent) still have very low mobile-cellular penetration levels. More advanced, broadband Internet access is scarce: fixed broadband is almost non-existent, with penetration rates of less than 1 per cent in almost all LCCs. Wireless broadband, although below 5 per cent penetration in the vast majority of LCCs, has registered important increases in countries such as Republic of the Congo (from 2 per cent in 2012 to 10.5 per cent in 2013), Lesotho (from 7 per cent in 2012 to 11 per cent in 2013) and Senegal (from 3.5 per cent in 2012 to 15 per cent in 2013). The increased availability of wireless broadband could help bring more people online in LCCs. Today, in the majority of LCCs, few people use the Internet: an estimated less than 2 per cent the population is online in Eritrea, Myanmar, Guinea, Niger and Ethiopia.

The majority of LCCs are in Africa and they closely match the list of least developed countries (LDCs). Among the factors holding back improved access to ICTs in LDCs are low education and literacy rates, a generally poor infrastructure and limited or lack of access to electricity (UN-OHLLS, 2013). However, Bhutan and Sudan, both LDCs included in the IDI 2013 that are not considered as LCCs, show that even LDCs can achieve a higher level of ICT development. There are also some non-LDCs among the least connected, most notably such populous economies as India, Pakistan and Nigeria. In total, close to 2.5 billion people live in LCCs, which is more than one-third of the world's total population. Special policy attention should be directed towards connecting people in LCCs, because they are most in need of improved access to ICTs and could benefit most from ICTs to advance socio-economic development.

Figure Box 2.2: Least connected countries (LCCs), 2013



Source: ITU.

the profitability of various kinds of economic activities" (Sachs, 2012). This section will explore to what extent geographic and other variables are important in terms of ICT development.

Methodology

In order to better understand the relationship between IDI, the economy, geography and population, the following variables were selected for each country:

- **Urban population**: refers to population living in urban areas, expressed as percentage of total population, as defined by national statistics offices

- **Population density**: refers to the mid-year population divided by land area in square kilometers

- **Population size**: refers to the size of the population of a country

- **Land area**: refers to a country's total area, excluding area under inland water bodies, national claims to continental shelf and exclusive economic zones. In most cases, the definition of inland water bodies includes major rivers and lakes.

- **Gross national income (GNI) per capita**: GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.[38] It is the total domestic and foreign output by residents of a country and consists of gross domestic product (GDP) plus factor incomes earned by foreign residents, minus income earned in the domestic economy by non-residents. GNI, calculated in national currency, is usually converted to United States dollars at official exchange rates for comparisons across economies, although an alternative rate is used when the official exchange rate is judged to diverge by an exceptionally large margin from the rate actually applied in international transactions.

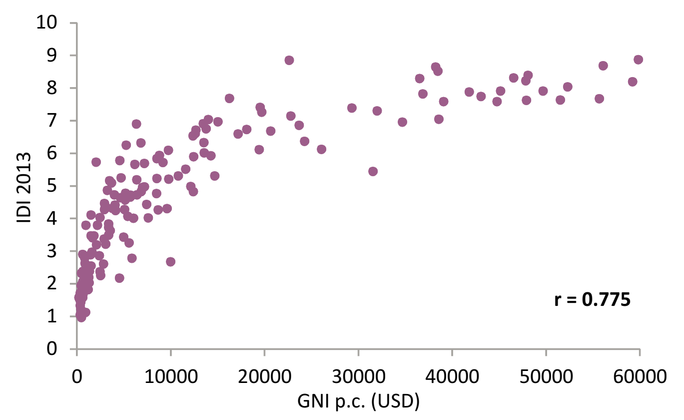
Apart from the potential relationship of these variables with ICT developments, they were selected for their high data availability for a large number of countries.

Past editions of this report (see MIS 2013) have pointed out the strong link between IDI and GNI, and the preceding sections highlighted the differences that persist in terms of ICT development between developed and developing countries.

In order to test the relationship between GNI and the other selected variables, a simple correlation analysis was conducted between IDI, the variables mentioned above and GNI per capita (p.c.). Results show that there is a strong and significant correlation between IDI and GNI p.c. ($r = 0.78$) (Chart 2.8). Furthermore, there is a strong and significant positive correlation between GNI p.c. and the percentage of population living in urban areas. In other words, the higher the level of GNI p.c. in a country, the higher the percentage of the population living in urban areas. There is also a significant, albeit weak correlation between GNI p.c. and population density, indicating that countries with a high GNI p.c. generally have a high population density.

Given the strong correlation of GNI p.c. with IDI, a partial correlation analysis between geographic factors, population factors and IDI value was conducted in which GNI p.c. was used as a control variable. This type of analysis makes it possible to look at the correlation while discounting for the effects of GNI p.c. The partial correlation analysis (Table 2.9) found a significant correlation between IDI and urban population, while no correlation was found between IDI and the other geographic and population variables. The following section looks at the results of the correlation analysis for each of the selected variables in more detail.

Chart 2.8: IDI and GNI per capita



Note: Countries with GNI p.c. values of more than USD 60 000 are excluded from the chart.
Source: ITU.

IDI and urban population

The results of the partial correlation analysis revealed that the percentage of population living in urban areas was the only variable that showed a relationship with IDI results. Although the correlation is moderate (r = 0.5), it is significant (see Table 2.9). This shows that the higher a country's share of population living in urban areas, the higher the values reached on the IDI (Chart 2.9).

This urban-rural divide can also be observed in a number of indicators included in the IDI, in particular those related to household ICT access, ICT skills and fixed telecommunication infrastructure.

Providing access to ICTs in rural areas of a country can be challenging, in particular in developing countries. Given the large investments that are required when deploying ICT infrastructure, private operators assess the profitability of providing their service depending on the demand and the specific business case in each geographic area. The marginal cost of service provision in densely populated urban areas is usually much lower than in rural areas. Furthermore, in many developing countries a higher proportion of lower-income populations, who might not be able to afford the service, live in rural areas, with the result that operators are not sure of obtaining a return on their investment. This points to other important factors, apart from service availability, that explain why countries with large rural populations have lower IDI values. People living in rural areas, in particular in developing countries, generally have a lower socio-economic status compared with their urban counterparts. High service costs and lack of ICT skills (see Chapter 1) have been identified as major barriers to increased use of ICTs, and are of particular relevance to rural populations in developing countries.

Chapter 1 of this report drew attention to the significant and persistent urban-rural digital divide. On the one hand, mobile-cellular coverage for rural populations has reached very high levels, with almost 90 per cent of the world's rural inhabitants covered by a 2G mobile-cellular signal by 2013. On the other hand, 3G mobile-cellular coverage was comparatively low for

Table 2.9: Partial correlation analysis of IDI, population and geographic characteristics

Control Variable	Correlations					
		IDI	Population size	Population density	Land area	Urban population
GNI per capita	IDI	1	-0.032	0	0.017	0.501*
	Population size	-0.032	1	-0.009	0.455*	-0.045
	Population density	0	-0.009	1	-0.090	0.101
	Land area	0.017	0.455*	-0.090	1	0.075
	Urban population	0.501*	-0.045	0.101	0.075	1

Note: Data on urban population, population density, land area and GNI p.c. are sourced from the World Bank. Data on population size are sourced from UNPD. *Correlation is significant at 0.01 level.
Source: ITU.

rural populations. The rural-urban divide is most pronounced when it comes to data on Internet access and use. Access to the Internet (be it narrowband or broadband, fixed or wireless) is extremely low for rural households in developing countries, while rural households in developed countries enjoy comparable access to their urban counterparts, albeit with slight variations in type of access and (usually) a small lag in levels of penetration.

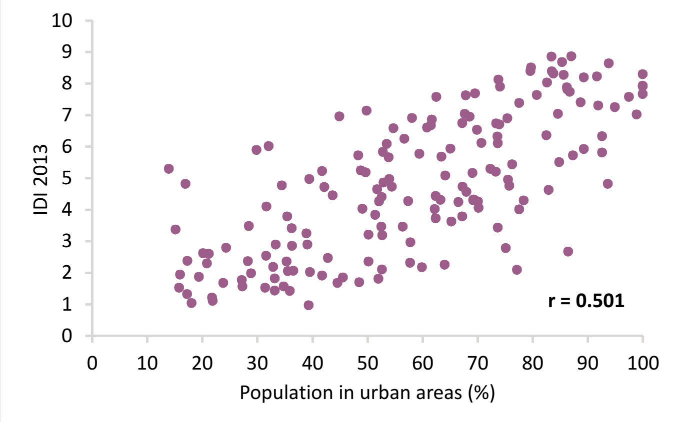
IDI and population density

The partial correlation analysis did not find a significant correlation between IDI value and population density (r = 0). This indicates that the level of population density does not make any difference in terms of the IDI values that countries attain. Chart 2.10 illustrates, for example, that countries with low population densities exhibit very different levels of ICT development, and may be anywhere on the scale from IDI top performers (such as Denmark, Sweden, Norway and Finland) to LCCs (such as Chad, Niger, and Central African Republic). Rather than population density, therefore, it is the concentration of people in certain areas of a country (i.e. percentage of population in urban areas) that seems to play a role in determining ICT development. This is the case, for example, of the top ten countries in the IDI 2013, where the percentage of population living in urban areas are all above 80 per cent.

IDI and population size

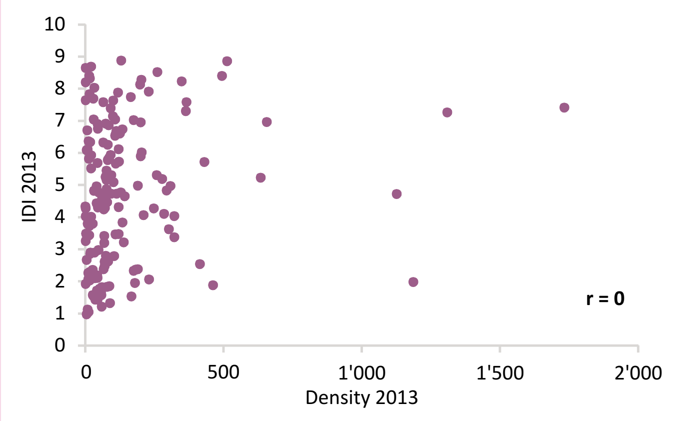
The partial correlation analysis did not find a significant relationship between IDI value and population size (r = -0.032) (see Chart 2.11). This means that the total size of the population of a country does not play any role in determining levels of ICT development achieved. Countries with small populations include both IDI top performers (such as Monaco, Iceland and Luxembourg) and LCCs (such as Solomon Islands, Djibouti and Swaziland), while countries with larger populations also exhibit very diverse IDI values (e.g. Japan, United States, France and Germany). These findings are independent of the country's economic level, as the correlation analysis was controlled for the effect of the GNI p.c. When it comes to ICT development, it may be that the potentially positive and negative factors related to population size cancel each other out. For instance, while a large population naturally means that more people have to be connected and become digital citizens, a larger customer base allows ICT service providers to benefit from economies of scale.

Chart 2.9: IDI and percentage of population living in urban areas



Source: ITU.

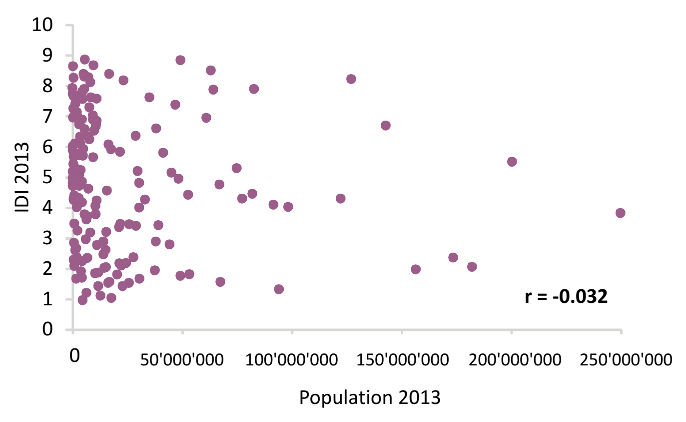
Chart 2.10: IDI and population density



Note: Chart excludes countries with a population density above 2 000 people per km² of land area.

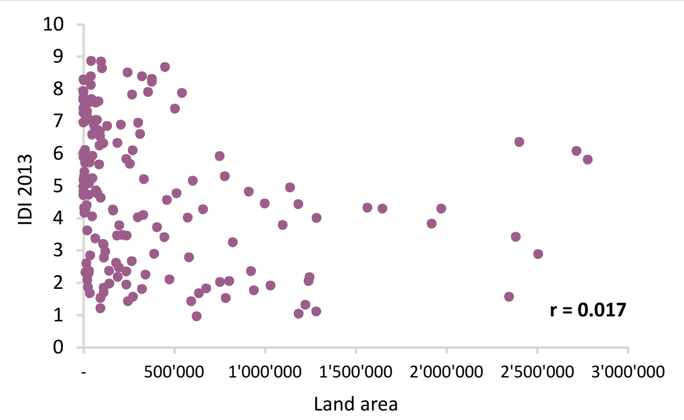
Source: ITU.

Chart 2.11: IDI and population size



Note: Chart excludes China and India.
Source: ITU.

Chart 2.12: IDI and land area



Note: Chart excludes countries with a land area above 3 million km^2.
Source: ITU.

IDI and land area

The partial correlation analysis did not find a significant relationship between IDI value and the size of countries' land areas (r = 0.017) (see Chart 2.12). This indicates that countries reach very different IDI levels irrespective of geographic size (see Chart 2.12). For example, some economies with small land areas such as Barbados, Bahrain, Hong Kong (China), Singapore, Monaco, Iceland and Luxembourg have high IDI levels, while the opposite is true for LCCs with small land areas (such as Gambia, Rwanda and Swaziland).

Conversely, countries with large land areas (such as Australia, Canada and the United States) can also have high IDI levels, while there are LCCs with large geographic areas such as India, Democratic Republic of the Congo and Chad.

In conclusion, the strongest relationship remains that between IDI levels and the size of a country's economy (measured by GNI p.c.). GNI levels are also correlated with other variables, such as population density and share of urban population.

Discounting the effect of GNI levels, the analysis revealed that there is a relationship between ICT performance and share of urban population, while no relationship was found with the other selected geographic variables. The results confirm the strong need to address the urban-rural digital divide that prevails in many developing countries. People living in rural areas, particularly in developing countries, are disadvantaged compared to their urban counterparts because of lower service coverage; they also often lack the economic means to pay for broadband Internet services, as well as the skills to make effective use of ICTs. This applies in particular to most LCCs identified earlier in this chapter (Box 2.2). The majority of LCCs have large rural populations: in 25 out of the 42 LCCs, less than 35 per cent of the population lives in urban areas, and these closely correspond to the list of LDCs.

2.5 IDI and progress towards the Millennium Development Goals (MDGs)

ICTs as development enablers

There is plenty of anecdotal evidence from initiatives in the field of ICT for development that points to the potential impact of ICTs on development. However, quantitative hard evidence of this impact is still limited, especially when looking beyond measuring the economic impact. A growing number of studies suggest that ICTs are enablers of all three pillars of sustainable development: social development, economic development and environmental sustainability. In terms of economic development, apart from the ICT sector being an important industry in its own right, studies have linked the expansion of broadband networks and ICT applications to GDP growth and job creation.[39] ICTs also provide increased access to education, government and health services, and empower people by providing a platform for communication, the impacts of which are more difficult to measure.

Since the Millennium Declaration was issued in 2000, ICTs have grown unprecedentedly, a trend which has underscored their potential for enabling socio-economic development. In 2000, the international community was only starting to grasp the "catalytic potential of ICTs to advance development agendas and priorities".[40] The potential of ICTs was further emphasized by the World Summit on the Information Society (WSIS), the first phase of which was held in 2003. WSIS recognized ICTs as a transformational technology and as a key to advancing social and economic development. It pointed to the potential of ICTs as enablers for the achievement of internationally agreed development goals, and the need to extend access to ICTs (Box 2.3); for access to ICTs also means access to information and services that may have previously been unavailable, especially to people living in rural and remote areas. ICTs can make a difference in many areas covered by the MDGs, such as poverty reduction and food security (MDG 1), education (MDG 2), gender equality (MDG 3), health (MDG 4, MDG 5, MDG 6) and environmental sustainability (MDG 7). Table 2.10 provides some examples of how ICTs can contribute to each of the MDGs. ICTs are also directly recognized under MDG 8 (Develop a global partnership for development), in Target 18.F: "in cooperation with the private sector, make available the benefits of new technologies, especially information and communications".

Measuring the link between IDI and the MDGs

The aim of this analysis is to assess the link between ICT development and achievement of the MDGs. It represents an initial attempt to quantify the relationship between ICT development (as measured by the IDI) and the MDGs, and a contribution to the ongoing discussions on the potential of ICTs as development enablers. Such an analysis is particularly timely at this juncture, in the year before the target date for achievement of the MDGs.

Methodology

In order to explore the relationship between IDI and the MDGs, a correlation analysis between IDI values and MDG indicators was conducted for 2011 where data are available for both sets of indicators. The following steps were performed:

- First, developed countries were excluded from the analysis in order to make the results more meaningful for developing countries, which are the target group of the MDGs. A total of 101 developing countries are included in the analysis.

- Second, from the total of 60 official MDG indicators used to measure progress towards the eight MDGs, 38 were identified in respect of which data pertaining to both the MDG indicators and the IDI are available for at least 16 countries.[41] The MDG indicators measuring Goal 2 (literacy rate and enrolment in primary education) and Goal 8 (fixed-telephone and mobile-cellular penetration and percentage of Internet users) were not considered, since they are also included in the IDI.

- Third, a simple correlation analysis between IDI, GNI p.c. and MDG indicators was performed in order to explore the relationship between the different indicators. The results of the simple correlation analysis confirmed a significant

Box 2.3: WSIS and ICT progress as measured by IDI 2002 and 2013

In accordance with the Millennium Development Goals (MDGs), the 2003 phase of the World Summit on the Information Society (WSIS) held in Geneva agreed on a Declaration of Principles and a Plan of Action, setting ten targets and several action lines to be achieved by 2015. The targets put forward under the Plan of Action aim, *inter alia*, to improve ICT connectivity in villages, schools, scientific and research institutions, libraries, museums, post offices, national archives and government agencies, as well as adapting primary and secondary school curricula to meet the challenges of the information society; support the development of multilingualism on the Internet; and ensure access to ICTs for more than half of world's inhabitants.

The Final WSIS Targets Review carried out by the Partnership on Measuring ICT for Development (2014) found that "while ICTs have grown tremendously and an increasing number of people are joining the global information society, major differences in ICT uptake and use persist." An analysis of the IDI over the WSIS period confirms this finding. A comparison of IDI values of the 147 economies for which data were available for 2002 and 2013 shows that the global IDI value has almost doubled from 2.52 in 2002 to 4.88 in 2013, underlining the considerable growth in ICT networks over the past decade. Tremendous increases in ICT access and use were recorded in both developed and developing countries. In absolute terms, the IDI increased most in developed countries, but, given their lower starting value, developing countries saw a higher relative growth in IDI from 2002 to 2013 (111 per cent). However, there was already a significant difference in terms of ICT development between developed and developing countries in 2002, and this divide is even more pronounced in 2013 (see Chart Box 2.3).

Looking at the differences in IDI within each of the two groups (developed countries and developing countries), an important increase in range can be observed in the latter. The minimum IDI value reached in the group of developing countries increased only slightly (+0.62) compared to the maximum IDI value (+1.89), which shows that the developing countries at the bottom and the top are moving at different speeds. The coefficient of variation decreased within both groups from 2002 to 2013, showing that differences within the groups are becoming less pronounced. Still, developing countries have a much higher coefficient of variation, underlining the diversity of ICT development within that group (see Table Box 2.3).

The Partnership report confirmed this finding and pointed out that while in a number of developing countries good progress has been made in connecting people, the world's LDCs are falling behind in terms of ICT development. The analysis of WSIS Target 1 (Connect all villages with ICTs and establish community access points) further showed that the gap in connectivity between rural and urban areas is widening. Earlier in this chapter, the significant correlation between IDI and urbanization was discussed, confirming that countries with a higher proportion of the population living in urban areas generally reach higher levels of ICT development (see section 2.4).

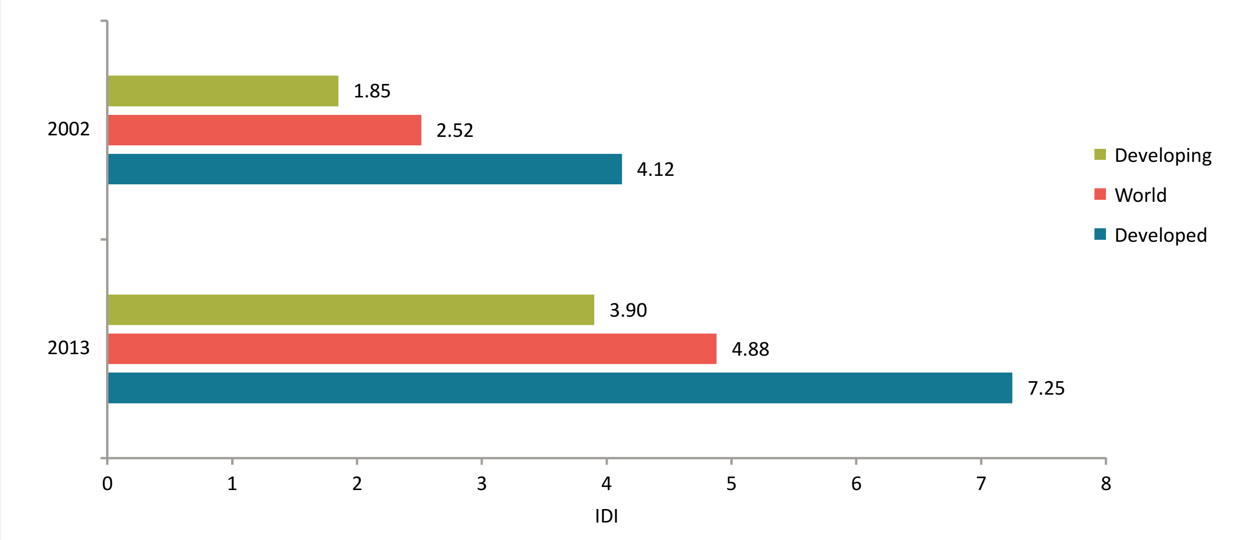
At the same time, ICTs have brought enormous benefits over the past decade and revolutionized many sectors, from education and health to government and culture. The Partnership (2014) therefore "emphasizes the important role of ICTs in the achievement of broader development goals and recommends that any future ICT monitoring framework should be closely linked to the broader post-2015 development agenda in order to help achieve this future development agenda."

Table Box 2.3: IDI 2002 and 2013 by level of development

	IDI 2002						IDI 2013						Change in average value 2002-2013 (absolute)	Change in average value 2002-2013 (relative)
	Average value*	Min.	Max.	Range	StDev	CV	Average value*	Min.	Max.	Range	StDev	CV		
World	2.52	0.41	6.07	5.66	1.47	58.34	4.88	1.03	8.86	7.83	2.20	44.99	2.37	94.1%
Developed	4.12	1.96	6.07	4.10	1.16	28.15	7.25	4.72	8.86	4.14	1.02	14.08	3.13	75.9%
Developing	1.85	0.41	5.92	5.51	0.99	53.47	3.90	1.03	8.85	7.81	1.76	45.11	2.05	110.8%

Note: Simple averages. The IDI 2002 was re-calculated based on the same methodology as the IDI 2013. The IDI 2002 and IDI 2013 figures were based on the same set of 147 economies in order to ensure comparability. Therefore, IDI 2013 values differ from what was presented in previous sections of this chapter.
Source: ITU.

Chart Box 2.3: IDI 2002 and 2013 by level of development



Note: Simple averages based on 147 economies.
Source: ITU.

strong correlation between GNI p.c., (most) MDG indicators and IDI.

- Fourth, in order to look at the relationship between IDI and MDGs while discounting the effects of GNI p. c., a partial correlation analysis was performed using GNI p.c. as the control variable.

There are important limitations to this analysis and interpretation of the results. Many factors play a role in progress towards the MDGs. While statistically significant correlations are indeed observed between numerous MDG indicators and the IDI, the results do not show how this relationship works, and should not be interpreted as identifying a causal relationship between the IDI and MDG indicators. Nor does this analysis examine the impact of ICTs on the MDGs: this would require different sets of data (including micro data) collected from official surveys.

Therefore, the analysis should be considered as a first step in an attempt to quantify the relationship between ICT performance and MDG progress. The results of the correlation analysis help identify the statistical association between the MDG indicators and the IDI, by analysing how movements in the value of one are related to movements in the value of the other. While ICTs are often recognized as development enablers, the results of this analysis reveal that the link between ICTs and development is not identical across development goals. This information can provide guidance for future research and contribute to the debate on the impact of ICTs on development, pointing to areas where ICTs could be particularly powerful tools to foster progress.

Table 2.11 and the analysis that follows present the results of the partial correlation analysis between the IDI and MDG indicators and highlight that:

- There is a statistically significant relationship between the IDI and 20 (out of 38) MDG indicators for which sufficient data are available
- Almost all MDG indicators that are included under MDG 1, MDG 4, MDG 5, MDG 6 and MDG 7 show significant correlations with the IDI (Figure 2.4)
- There is non-significant correlation for indicators under MDG 3 and MDG 8.

Table 2.10: Examples of contribution of ICTs towards the Millennium Development Goals

Millennium Development Goal	Contribution of ICTs
MDG1 (Eradicate extreme poverty and hunger)	• Increase GDP growth and job creation • Locate and track outbreaks of disease and famine • Provide more accurate weather information that helps to increase agricultural production • Delivery of real-time market information/sales prices for farmers
MDG2 (Achieve universal primary education)	• Improve access to education through mobile technologies/remote learning • Train teachers through ICT-enhanced services and create networks among teachers • Broaden the availability of quality educational materials/resource • Increase access to linguistically and culturally diverse educational content
MDG3 (Promote gender equality and empower women)	• Greater access to financial services for women entrepreneurs • Deliver educational and literacy programmes specifically targeted to poor girls and women using appropriate technologies
MDG4 (Reduce child mortality)	• Data collected through ICT applications allow health professionals to assess child health and well-being, compare indicators across localities and regions, and make better-informed public policy decisions • Online communities of parents and/or paediatricians facilitate exchange between experts and parents and contribute to the attainment of physical, mental and social well-being for infants
MDG5 (Improve maternal health)	• Monitoring of maternal health via text, voice messaging and mobile apps • Online platforms are serving as an information and communication hub for health facilities and supporting conversations between community health workers, midwives, clinicians and expectant mothers
MDG6 (Combat HIV/AIDS, malaria and other diseases)	• Increase access to reproductive health information, including information on prevention of diseases • Content-sharing platforms that apply mobile services to raise awareness about AIDS and condom use • Monitoring and treatment of patients (e.g. SMS reminders for appointments or medical treatment) • Improve access to medical databases and electronic health records (EHRs) • Link community health workers to the national health system/specialist support
MDG7 (Ensure environmental sustainability)	• Reduce greenhouse gas (GHG) emissions through dematerialization of physical products and systems, for example by substituting the need to produce physical products through the delivery of e-products and services • Climate adaptation: Smart planning and reliable access to real-time data for climate monitoring, as well as the implementation of early warning systems • Reduce energy and water consumption through smart transportation and logistics, dematerialization and other technologies. • Smart grids can reduce energy consumption through improved heating, cooling and monitoring technologies

Source: ITU and Broadband Commission.[42]

Table 2.11: Results of partial correlation analysis between IDI and MDG indicators

Millennium Development Goals (MDGs)			
Goals and Targets (from the Millennium Declaration)	**Indicators for monitoring progress**	**Partial correlation coefficient and level of significance[43]**	**Number of countries included**
Goal 1: Eradicate extreme poverty and hunger			
Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	1.1 Proportion of population below $1 (PPP) per day	-0.584 **	24
	Population below the national poverty line[44]	-0.471 **	42
	1.2 Poverty gap ratio	-0.480 *	24
	1.3 Share of poorest quintile in national consumption	-	
Target 1.B: Achieve full and productive employment and decent work for all, including women and young people	1.4 Growth rate of GDP per person employed	-0.263	43
	1.5 Employment-to-population ratio	-0.138	50
	Ratio of youth unemployment rate to adult employment rate	0.100	40
	1.6 Proportion of employed people living below $1 (PPP) per day	-0.715 **	12
	1.7 Proportion of own-account and contributing family workers in total employment	-	
Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	1.8 Prevalence of underweight children under five years of age	-0.354	39
	1.9 Proportion of population below minimum level of dietary energy consumption	-0.502 **	81
Goal 2: Achieve universal primary education			
Target 2.A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	2.1 Net enrolment ratio in primary education	+	
	2.2 Proportion of pupils starting grade 1 who reach last grade of primary	+	
	2.3 Literacy rate of 15-24 year-olds, women and men	+	
Goal 3: Promote gender equality and empower women			
Target 3.A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015	3.1 Ratios of girls to boys in primary, secondary and tertiary education	+	
	3.2 Share of women in wage employment in the non-agricultural sector	-	
	3.3 Proportion of seats held by women in national parliament	-0.023	90
Goal 4: Reduce child mortality			
Target 4.A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	4.1 Under-five mortality rate	-0.744 **	90
	4.2 Infant mortality rate	-0.751 **	90
	4.3 Proportion of 1 year-old children immunized against measles	0.425 **	90
Goal 5: Improve maternal health			
Target 5.A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio	5.1 Maternal mortality ratio	-0.746 **	89
	5.2 Proportion of births attended by skilled health personnel	0.526 **	45
Target 5.B: Achieve, by 2015, universal access to reproductive health	5.3 Contraceptive prevalence rate	-	
	5.4 Adolescent birth rate	-0.512 **	35
	5.5 Antenatal care coverage (at least one visit and at least four visits)	0.529 **	32
	5.6 Unmet need for family planning	-	

Table 2.11: Results of partial correlation analysis between IDI and MDG indicators (continued)

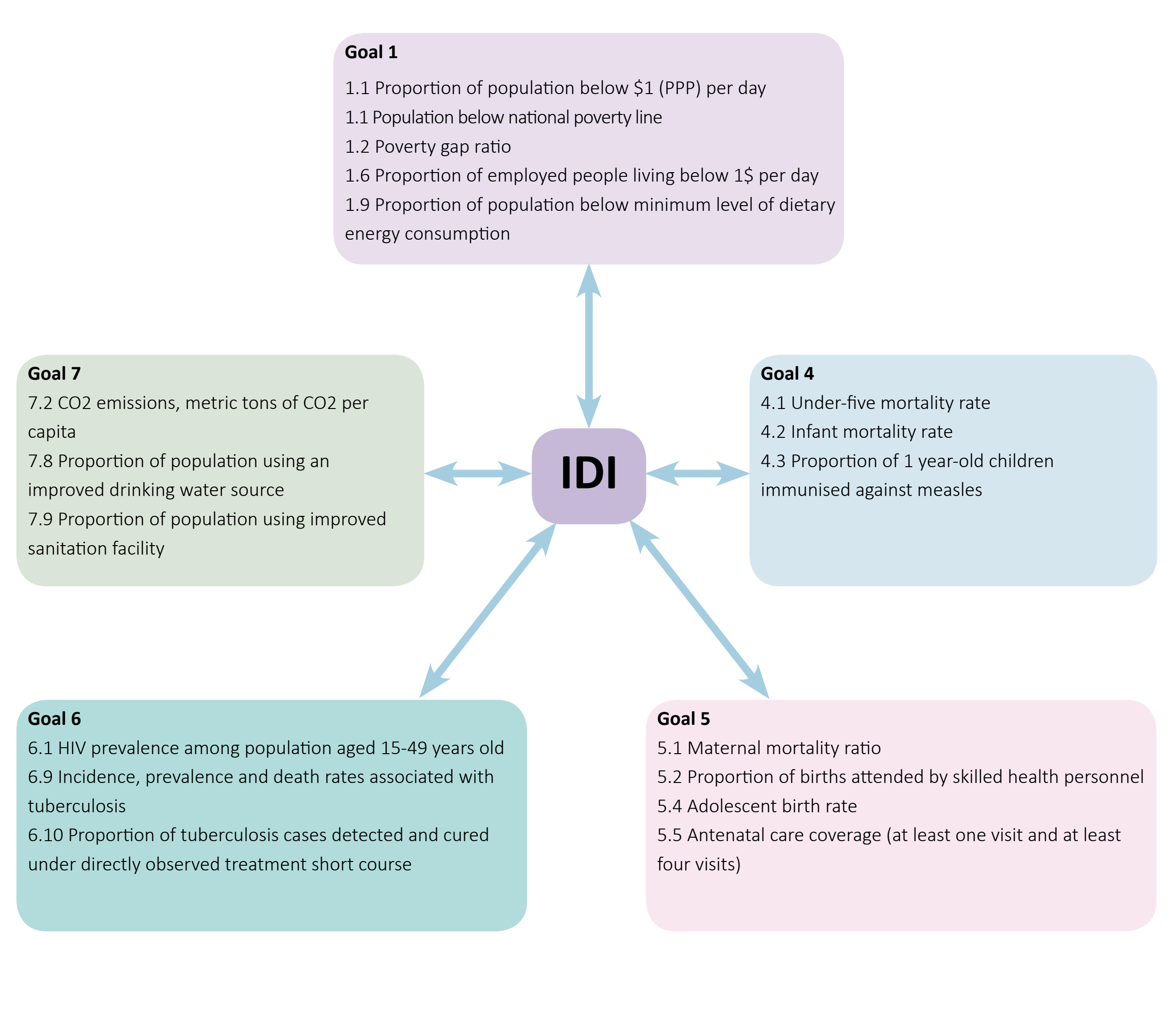
Millennium Development Goals (MDGs)			
Goals and Targets (from the Millennium Declaration)	**Indicators for monitoring progress**	**Partial correlation coefficient and level of significance[43]**	**Number of countries included**
Goal 6: Combat HIV/AIDS, malaria and other diseases			
Target 6.A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	6.1 HIV prevalence among population aged 15-24 years	-0.225 *	83
	6.2 Condom use at last high-risk sex	0.196	37
	6.3 Proportion of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS	-	
	6.4 Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years	-	
Target 6.B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it	6.5 Proportion of population with advanced HIV infection with access to antiretroviral drugs	-0.073	78
Target 6.C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	6.6 Incidence and death rates associated with malaria	-	
	6.7 Proportion of children under 5 sleeping under insecticide-treated bed nets	-	
	6.8 Proportion of children under 5 with fever who are treated with appropriate anti-malarial drugs	-	
	6.9a Incidence rates associated with tuberculosis	-0.335 **	92
	6.9b Prevalence rates associated with tuberculosis	-0.404 **	92
	6.9c Death rates associated with tuberculosis	-0.471 **	92
	6.10a Proportion of tuberculosis cases detected under directly observed treatment short course	0.388 **	92
	6.10b Proportion of tuberculosis cases cured under directly observed treatment short course	-0.071	92
Goal 7: Ensure environmental sustainability			
Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	7.1 Proportion of land area covered by forest	-	
	7.2 CO2 emissions, total, per capita and per $1 GDP (PPP)	0.368 **	89
	7.3 Consumption of ozone-depleting substances	0.146	89
Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.4 Proportion of fish stocks within safe biological limits	-	
	7.5 Proportion of total water resources used	-	
	7.6 Proportion of terrestrial and marine areas protected	0.037	92
	7.7 Proportion of species threatened with extinction	-	
Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.8 Proportion of population using an improved drinking water source	0.377 **	90
	7.9 Proportion of population using an improved sanitation facility	0.581 **	90
Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	7.10 Proportion of urban population living in slums	-	

Table 2.11: Results of partial correlation analysis between IDI and MDG indicators (continued)

Millennium Development Goals (MDGs)			
Goals and Targets (from the Millennium Declaration)	**Indicators for monitoring progress**	**Partial correlation coefficient and level of significance[43]**	**Number of countries included**
Goal 8: Develop a global partnership for development			
Target 8.A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system Includes a commitment to good governance, development and poverty reduction – both nationally and internationally	*Some of the indicators listed below are monitored separately for the least developed countries (LDCs), Africa, landlocked developing countries (LLDCs) and small island developing states (SIDS)* Official development assistance (ODA) 8.1 Net ODA, total and to the LDCs, as percentage of OECD/DAC donors' gross national income 8.2 Proportion of total bilateral, sector-allocable ODA of OECD/DAC donors to basic social services (basic education, primary healthcare, nutrition, safe water and sanitation)	- -	
Target 8.B: Address the special needs of the least developed countries Includes: tariff and quota free access for the least developed countries' exports; enhanced programme of debt relief for heavily indebted poor countries (HIPC) and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction	8.3 Proportion of bilateral official development assistance of OECD/DAC donors that is untied 8.4 ODA received in LLDCs as a proportion of their gross national incomes 8.5 ODA received in SIDS as a proportion of their gross national incomes	- 0.440 -0.338	 17 7
Target 8.C: Address the special needs of landlocked developing countries and small island developing states (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly)	Market access 8.6a Proportion of total developed-country imports (by value and excluding arms) from developing countries, admitted free of duty 8.6a Proportion of total developed country imports (by value and excluding arms) from least developed countries, admitted free of duty 8.7 Average tariffs imposed by developed countries on agricultural products and textiles and clothing from developing countries 8.8 Agricultural support estimate for OECD countries as a percentage of their gros domestic product 8.9 Proportion of ODA provided to help build trade capacity	-0.213 -0.222 - - -	90 23
Target 8.D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	Debt sustainability 8.10 Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative) 8.11 Debt relief committed under HIPC and MDRI Initiatives 8.12 Debt service as a percentage of exports of goods and services	- - 0.160	 71
Target 8.E: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries	8.13 Proportion of population with access to affordable essential drugs on a sustainable basis	-	
Target 8.F: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	8.14 Fixed-telephone subscriptions per 100 inhabitants 8.15 Mobile-cellular subscriptions per 100 inhabitants 8.16 Internet users per 100 inhabitants	+ + +	

Note: **Significant at 0.01 level. *Significant at 0.05 level. – Insufficient data. +The indicator or similar indicator is included in the IDI.
Source: UN for the list of MDG indicators and ITU for the correlation results.

Figure 2.4: Significant partial correlations between IDI and MDG indicators



Source: ITU.

The following section presents a more detailed analysis of the MDG indicators for which significant partial correlations with the IDI were found.

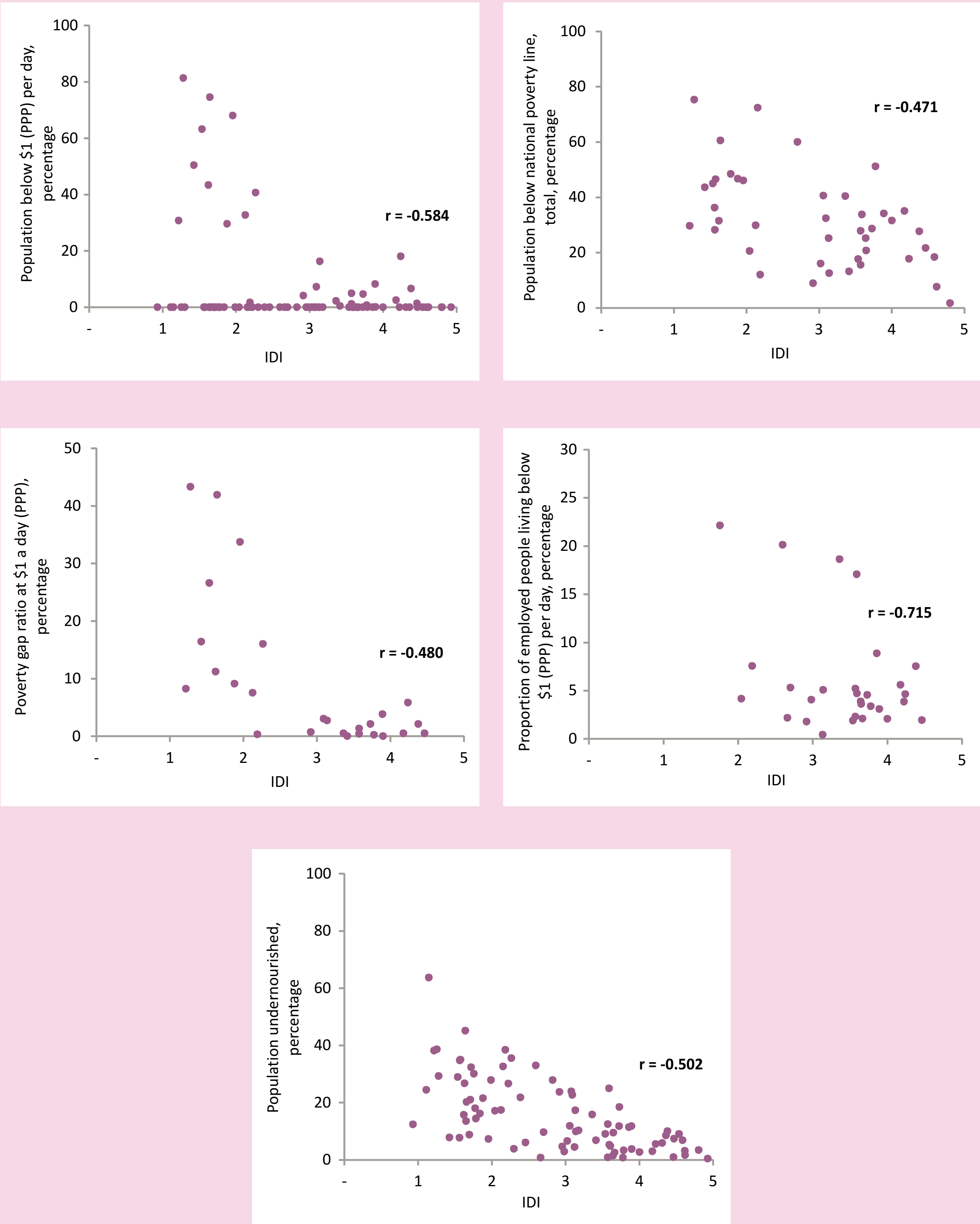
IDI and MDG 1: Eradicate extreme poverty and hunger

The results of the partial correlation analysis indicate that there is a significant negative correlation between IDI, on the one hand, and the proportion of people whose income is less than one dollar a day as well as the percentage of population that is undernourished, on the other. High IDI levels are associated with lower percentages of undernourished population and lower proportions of population living below the poverty line (Chart 2.13).

IDI and MDG 4: Reduce child mortality

A strong negative correlation was found between IDI and the indicators of MDG 4 on child and infant mortality, in other words, the higher the IDI, the lower infant and child

Chart 2.13: IDI and MDG 1: Halve the proportion of people whose income is less than one dollar a day and the proportion of people who suffer from hunger, 2011



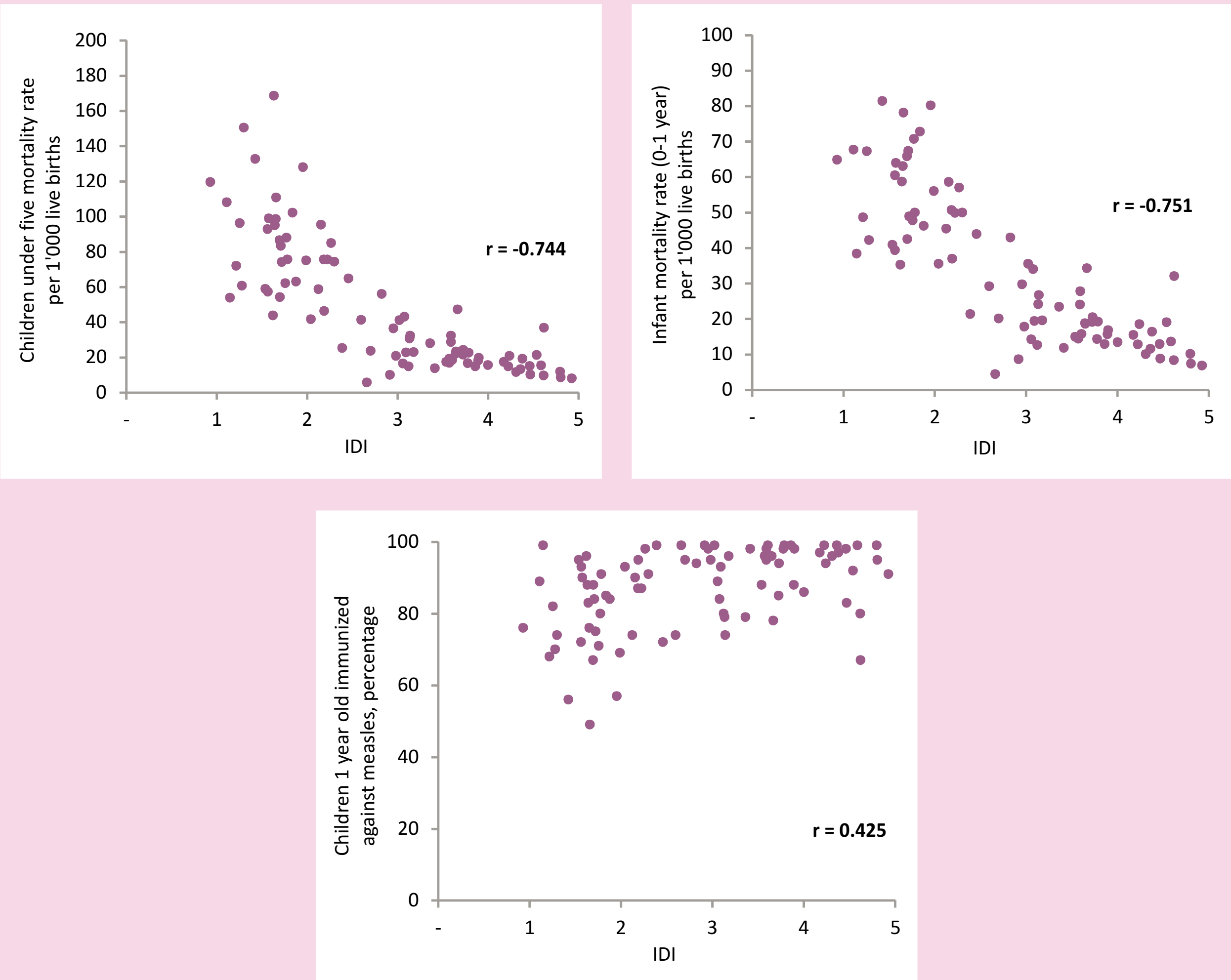
Source: ITU.

mortality rates (see Chart 2.14). There is also a significant positive relationship between the percentage of one year olds that are immunized against measles and the IDI, meaning the higher the IDI, the higher the proportion of children that are immunized. With regard to MDG 4, ICTs can contribute, for example, through improved monitoring and surveillance of infants and children, through the analysis of health data collected through public health applications and by serving as a platform for exchange and advocacy. In remote and rural areas, ICTs may be the main means of communicating during an emergency or of getting urgent medical attention remotely.

IDI and MDG 5: Improve maternal health

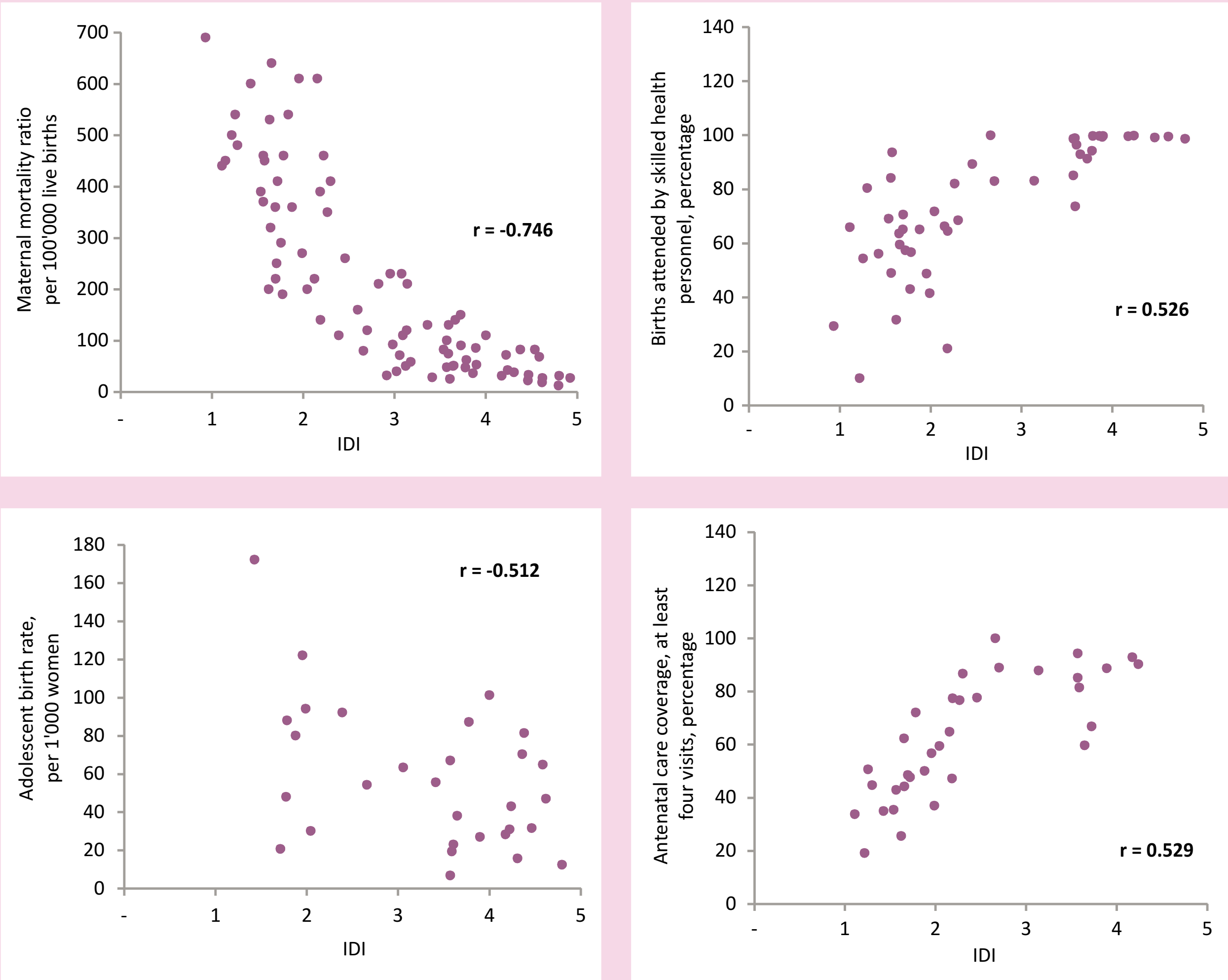
There is a significant negative correlation between IDI and the indicators of MDG 5 on maternal mortality and adolescent birth rate. Countries with higher IDI have lower levels of maternal mortality (see Chart 2.15) and lower adolescent birth rates. Attendance of skilled health personnel at birth and a minimum of antenatal care visits, both of which are positively correlated with IDI, are essential for reducing maternal mortality. ICTs can complement and facilitate those essential services through the monitoring of maternal health, for example, via SMS and by providing information-sharing platforms (see Box 2.4).

Chart 2.14: IDI and MDG 4: Reduce child mortality, 2011



Source: ITU.

Chart 2.15: IDI and MDG 5, Target 5.A: Reduce the maternal mortality ratio, 2011



Source: ITU.

IDI and MDG 6: Combat HIV/AIDS, malaria and other diseases

With regard to MDG 6 on combating HIV/AIDS, malaria and other diseases such as tuberculosis, it was observed that while the incidence and prevalence of malaria and tuberculosis and associated death rates decrease with higher IDI levels (as shown by a significant negative correlation), there was no relationship between treatment success rates and IDI levels. The same can be observed with regard to HIV/AIDS: the higher the IDI, the lower the percentage of people living with HIV, but no relationship exists between antiretroviral therapy coverage among people with advanced HIV and IDI (see Chart 2.16). ICTs can help raise awareness and provide access to health information, including information on preventive measures. They can be used in the monitoring and treatment of patients and can link practitioners to the national healthcare system (see Box 2.4)

IDI and MDG 7: Ensure environmental sustainability

MDG 7 Target 7.C: "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation" also displays a significant

Box 2.4: Thailand: Smart phones and volunteers fight drug-resistant malaria

In 2008, evidence showed that malaria parasites in Cambodia and Thailand were developing resistance to artemisinin, the most effective single drug for treating malaria. In response, the countries, with support from the World Health Organization (WHO), launched a joint monitoring, prevention and treatment project in seven provinces along their shared border. In Thailand, more than 300 volunteer village malaria health workers were trained to test for malaria and directly observe the treatment of patients with confirmed malaria in remote villages. The use of smartphones to capture essential data on the patients and monitor their treatment has accelerated progress. An electronic malaria information system (e-MIS) uploaded on the health workers' mobile devices shows malaria volunteers where to find patients and the status of their treatment, and helps analyse the situation and trends

Source: MDG Fact Sheet.[45]

positive correlation with IDI. The higher the IDI, the higher the proportion of the population using improved drinking water sources and sanitation facilities (see Chart 2.17). ICTs can contribute to the improved management of water and sanitation facilities, by providing timely information on weather and water management and locating new sources of water. Furthermore, ICTs such as mobile phones and the Internet can help inform people and allow them to share information on the use and availability of facilities.[46] Results are mixed for the other targets under MDG 7, no statistically significant relationship being observed between IDI and the proportion of terrestrial and marine areas protected (Target 7.B) or the consumption of ozone-depleting substances. On the other hand, a significant positive correlation exists between carbon dioxide (CO_2) emissions and IDI, countries with a higher IDI producing more CO_2. This points to the possible negative effects that ICTs can have on the environment, as the manufacture and use of ICTs and ICT equipment require increased energy consumption and lead to the production of e-waste.[47]

Linking IDI growth and progress towards achieving the MDGs

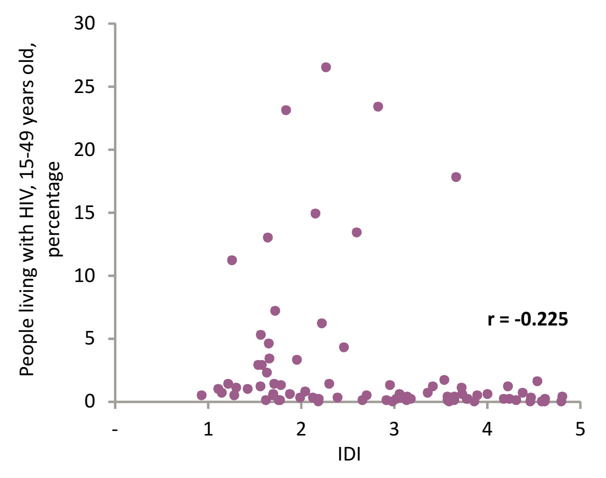
The first part of this section highlighted the significant correlations between IDI and a number of MDG indicators. It showed that developing countries with higher IDI levels generally fare better on numerous MDGs. To go one step further, this second part analyses the correlation between growth in IDI and changes in MDG indicators between the years 2002 and 2011. This analysis shows to what extent growth in the IDI can be associated with progress towards the MDGs over the ten-year period. For example, if increases in ICT developments lead to a reduction of the proportion of people that suffer from hunger, then the percentage increase in the IDI value is expected to be significantly and negatively correlated with the percentage decrease in the level of undernourished population in a country.

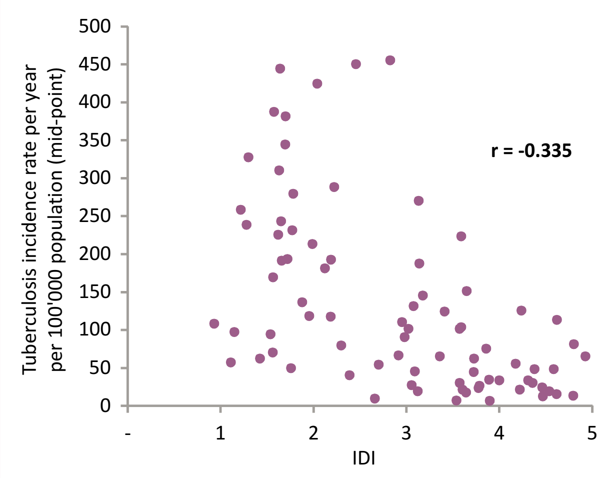
Methodology

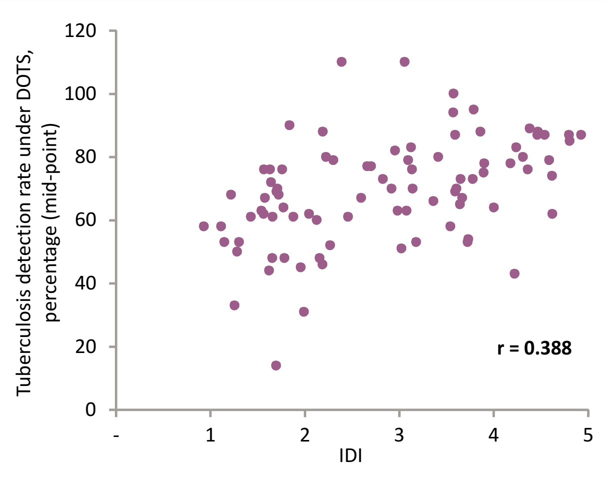
In order to explore the relationship between increases in IDI levels and changes in MDG indicators, a simple correlation analysis was carried out between the percentage change in IDI values and the percentage change in values of MDG indicators, where 2002 and 2011 data are available for both sets of indicators. The following steps were performed:

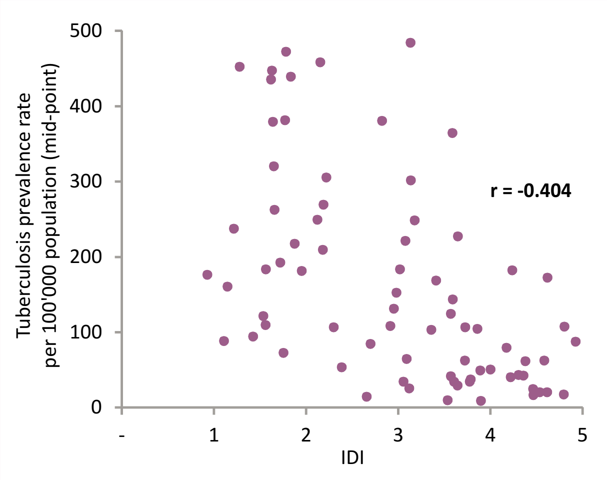
- As in the first part of this section, developed countries were excluded from the analysis in order to make the results more meaningful for developing countries, which are the target group of the MDGs.

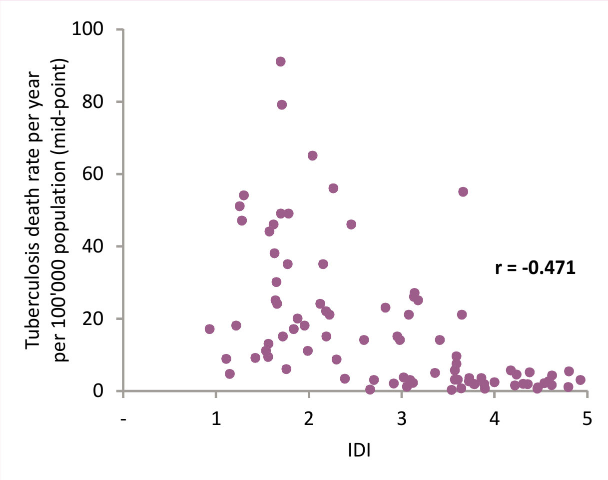
Chart 2.16: IDI and MDG 6, Target 6.C: Have halted by 2015 and begun to reverse the spread of HIV, malaria and other major diseases, 2011





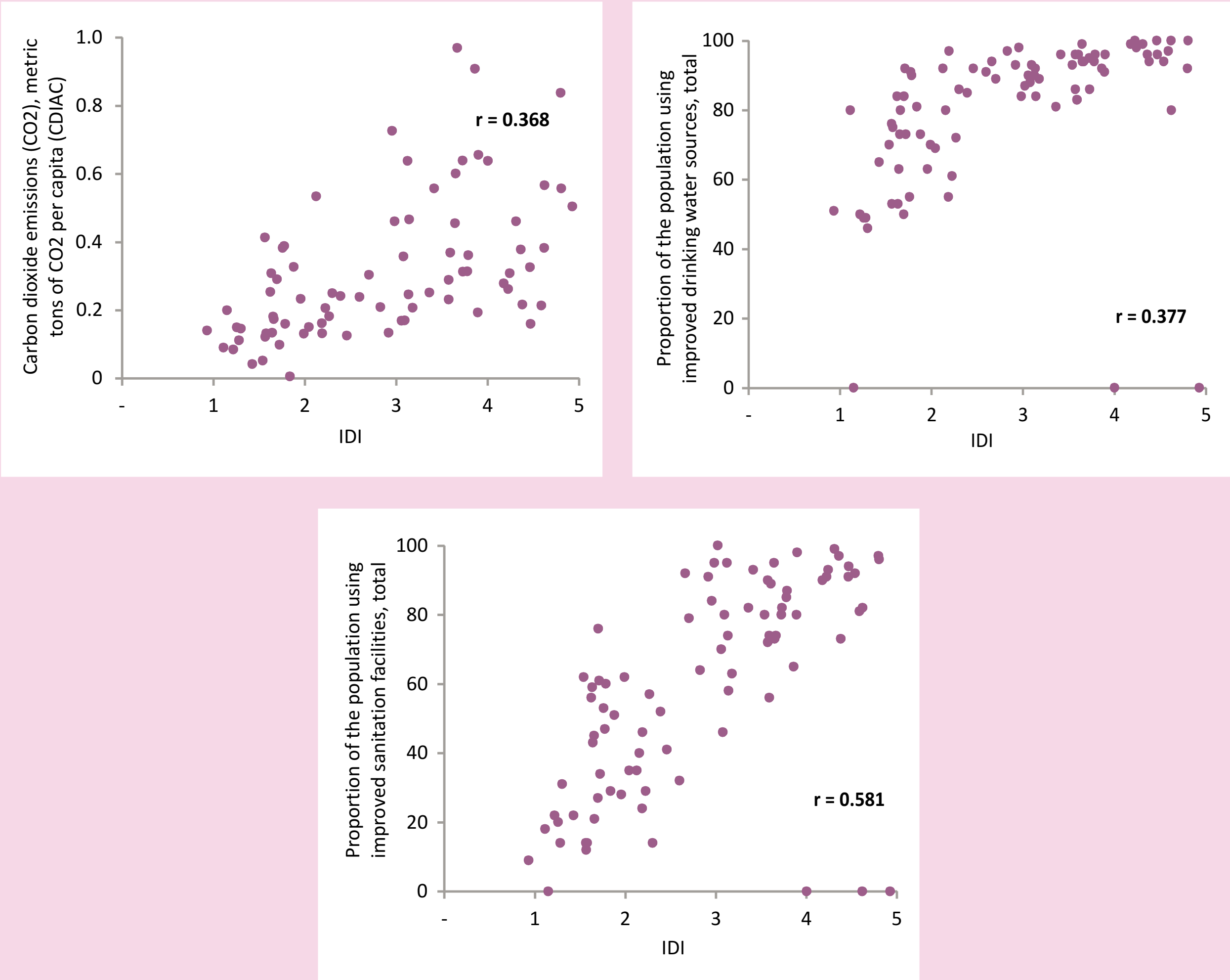






Source: ITU.

Chart 2.17: IDI and MDG 7, Target 7.C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation, 2011



Source: ITU.

- A simple correlation analysis between percentage change in IDI and percentage change in MDG indicators between 2002 and 2011 was performed. This analysis included the 38 indicators for which data are available for 2002 and 2011 for both the MDG indicators and the IDI. The number of countries included in the analysis ranges from 16 to 101. As the percentage change in MDG indicators over the time period under consideration is not correlated with GNI p.c., a simple correlation analysis is sufficient to examine the relationship between the indicators.

- A simple correlation analysis was further performed on subgroups of countries. The groups were derived using quartiles of countries according to their level of percentage change in IDI between 2002 and 2011. The four groups are: group 1 (percentage change of 0.70 or below), group 2 (percentage change of 0.71 to 0.82), group 3 (percentage change of 0.83 to 0.97) and group 4 (percentage change of 0.98 to 1.75). In addition, the performance of LDCs against non-LDCs was examined to explain where a stronger relationship exists (Table 2.12).

Findings

Out of the 38 indicators mentioned in the earlier section, the percentage change in value between 2002 and 2011 for nine MDG indicators was found to be significantly correlated with the percentage change in the IDI (Table 2.12 and Figure 2.5). The results derived from the simple correlation analysis are highlighted below.

Goal 1:

There is a significant negative correlation between percentage change (increase) in IDI and percentage change in the proportion of population living below the national poverty line, as well as between percentage change in IDI and percentage change in the undernourished population in developing countries. This means that there is a relationship between improved ICT access/usage and poverty reduction. In particular, countries that have improved their IDI levels the most between 2002 and 2011 (group 4) showed the strongest significant correlation with population below the poverty line. Conversely, countries with the lowest improvements in their IDI values (group 1) showed the weakest relationship.

Goal 3:

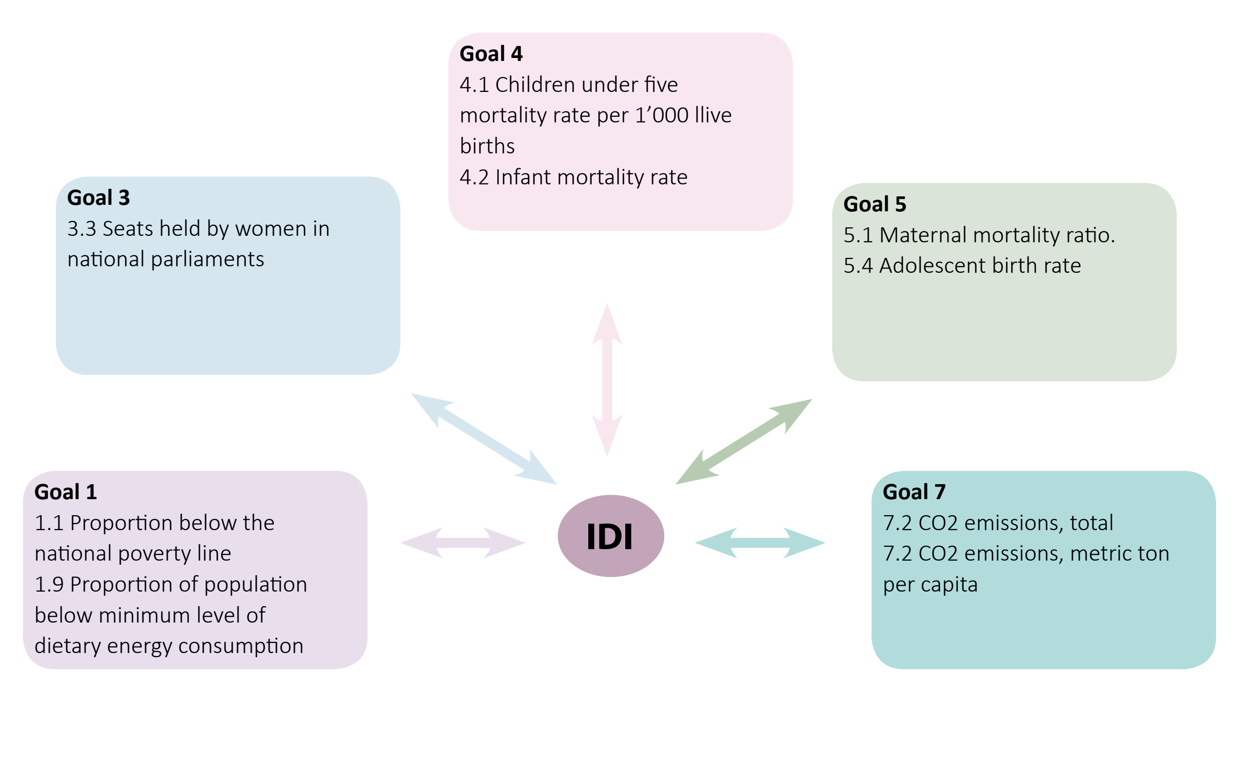
A significant positive correlation exists between percentage increase in IDI and percentage change in the number of seats held by women in parliament. Although no relationship existed between the IDI and this indicator in the earlier section where 2011 data were analysed, improvements in the level of ICT access and use between the ten-year periods have shown a positive relationship with improving gender equality and the role of women in parliament in developing countries, particularly in non-LDCs.

Table 2.12: Simple correlation analysis between relative change in IDI values and MDG indicators 2002-2011, developing countries

Target	MDG 1: Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	MDG 1: Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	MDG 3: Promote gender equality and empower women	MDG 4: Target 4.A: Reduce, by two-thirds, between 1990 and 2015, the under-five mortality rate		MDG 5: Improve maternal health		MDG 7: Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	
Indicator	Population below national poverty line, total, percentage	Population undernourished, percentage	Seats held by women in parliament, percentage	Infant mortality rate (0-1 years) per 1 000 live births	Children under five mortality rate per 1 000 live births	Maternal mortality ratio per 100 000 live births	Adolescent birth rate, per 1 000 women	CO2 emissions, total, thousand metric tons of CO2 (CDIAC)	CO2 emissions, metric ton of CO2 per capita (CDIAC)
Correlation coefficient	-0.545**	-0.189*	0.308**	-0.256*	-0.265**	-0.196*	0.372*	0.259*	0.215*

Note: * Significant at 0.05 level. ** Significant at 0.01 level
Source: ITU.

Figure 2.5: Significant correlations between percentage increases in IDI and percentage changes in MDG indicators, 2002 and 2011



Source: ITU.

Goals 4 and 5:

The results further highlighted a significant and negative correlation between percentage change in IDI and percentage changes in infant mortality, child mortality and maternal mortality. These results are particularly true in non-LDCs, where the IDI values increased more during the ten-year period than in LDCs. This can be due to several factors, including the attendance of skilled health personnel as well as the role that ICTs can play in complementing and facilitating the monitoring of health via SMS and increased availability of information thanks to the Internet.

Goal 7:

The significant positive correlation between percentage change in carbon dioxide (CO_2) emissions and percentage increase in IDI emphasizes a possible adverse impact that ICTs can exert on the environment. The use of ICTs requires electricity, which is one of the contributors to high CO_2 emissions. The combustion of fossil fuels to generate electricity is the largest single source of CO_2 emissions. Another important source of CO_2 emissions is industrial processes. High usage of ICT devices and frequent improvements and innovation on ICT devices result in increases in industrial production, and the growth of the ICT production sector entails industrial processes that emit CO_2 through fossil fuel combustion. Note that industrial processes also use electricity and therefore indirectly cause emissions from electricity production.

Conclusion

The analysis linking ICT and MDG indicators found statistically significant correlations between IDI values and numerous MDG indicators (20 out of 38 analysed). This shows that there is an important relationship between ICT development and other development indicators in developing countries.

Furthermore, the analysis comparing the relative change or increase in IDI and the relative change in MDG indicators between 2002 and 2011 found significant correlations between increases in IDI and progress towards selected MDG indicators. This suggests that ICT development could lead to improvements in other areas of social and economic development (with the exception of CO2 emissions, for which an unfavourable relationship was found).

The results presented in this section should be understood as a starting point for further quantitative analyses in the area of ICT and social and economic development. In order to better understand the relationship between ICT development and the MDGs, further research is needed. In particular, future research should focus on developing methodologies that can quantitatively assess the impact of ICTs on a range of socio-economic variables. This type of analysis will require different data sets, including micro data on ICT usage collected from official surveys. Micro data offer analysts and researchers ample information and considerable flexibility to apply quantitative models that identify relationships and interactions between indicators and topics covered in a survey, thereby fostering the diversity and quality of research and analysis.

Endnotes

1 This section is based on the 2013 edition of *Measuring the Information Society*. The presentation of the conceptual framework and methodology of the IDI is maintained in each version of the report. The reader is also advised to consult Annex 1 to this report, as well as the 2009 edition of *Measuring the Information Society* (ITU, 2009), which describe the methodology in more detail.

2 Data on the indicators included in the skills sub-index are sourced from the UNESCO Institute for Statistics (UIS). See Annex 1 for more details on the definition of the indicators.

3 See final report of the meeting: http://www.itu.int/en/ITU-D/Statistics/Pages/events/brazil2013/default.aspx and the ITU Manual for Measuring ICT Access and Use by Households and Individuals, 2014 (ITU, 2014).

4 For more information on the EGTI online forum see: http://www.itu.int/ITU-D/ict/ExpertGroup/default_group.asp. To join EGTI, visit: http://www.itu.int/ITU-D/ict/ExpertGroup/default.asp. To join EGH, visit: http://www.itu.int/net4/ITU-D/forum/expertgrouponhouseholds/forum/.

5 Household surveys traditionally ask about the availability of assets in the household, including TV, electricity, refrigerator, piped water, etc. A similar principle has been adopted for ICT equipment and services, i.e. they should be available for use by household members at home, regardless of whether they are used. They can be taken away from home occasionally, but the basic principle is that they are usually available for use by all household members at home.

6 Income classifications are based on the World Bank method: http://data.worldbank.org/about/country-classifications/country-and-lending-groups#High_income.

7 Based on 2011 data: https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DAE%20SCOREBOARD%202013%20-%203-INTERNET%20USE%20AND%20SKILLS.pdf.

8 http://presse.tdc.dk/pressemeddelelser/tdc-klar-til-100-mbit-s-ogsa-pa-kobberkabler-987457.

9 https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DK%20%20-%20Broadband%20markets.pdf.

10 http://www.gsma.com/spectrum/wp-content/uploads/DigitalDividend/DDtoolkit/auctions-summary.html#denmark and http://danishbusinessauthority.dk/800-mhz-auction.

11 http://europa.eu/rapid/press-release_IP-14-680_en.htm.

12 https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DAE%20SCOREBOARD%202013%20-%202-BROADBAND%20MARKETS%20.pdf.

13 http://europa.eu/rapid/press-release_IP-14-680_en.htm and http://ec.europa.eu/research/press/2013/pdf/ppp/5g_factsheet.pdf.

14 https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DAE%20SCOREBOARD%202013%20-%203-INTERNET%20USE%20AND%20SKILLS.pdf.

15 Qatar (ranked 34th) has 97 per cent of households with a computer by end 2013.

15 https://ec.europa.eu/digital-agenda/en/scoreboard.

17 Ofcom and the European Union define superfast services as those delivering download speeds of 30 Mbit/s or more.

18 https://ec.europa.eu/digital-agenda/en/pillar-4-fast-and-ultra-fast-internet-access.

19 In these countries, the in-scope population for data on Internet users is individuals aged 16-74.

20 Refers to the indicator active mobile-broadband subscriptions. Mobile-broadband subscriptions generally make up the largest part of wireless-broadband subscriptions, which also includes terrestrial (fixed) wireless and satellite broadband subscriptions.

21 http://www.itnewsafrica.com/2013/05/airtel-launches-first-3-75-g-service-in-burkina-faso/ and http://news.aouaga.com/documents/docs/RapportARCEP.pdf.

22 http://www.thisdaylive.com/articles/a-year-after-wacs-is-faster-more-affordable-mobile-broadband-becoming-a-reality-/156011/ and http://wacscable.com/index.jsp.

23 http://www.cvmovel.cv/nacional-gsm-3g-edge-e-gprs.

24 http://www.telecomasia.net/content/bhutan-telecom-expand-3g-network.

25 http://www.tashigroup.bt/?p=1058 and http://www.kuenselonline.com/tashicell-goes-3g/#.U4RlG3KSx8E.

26 http://www.kuenselonline.com/530-increase-in-mobile-broadband-users/#.U4RsGHKSx8E.

27 Purchased capacity.

[28] http://www.bbc.com/news/world-latin-america-26850393.

[29] http://www.entel.bo/inicio3.0/index.php/sala-de-prensa/item/309-contrato-entel-abe and http://www.entel.bo/inicio3.0/index.php/sala-de-prensa/item/272-telecentro-san-juan-de-chiquitos.

[30] http://www.eeca-ict.eu/countries/georgia.

[31] http://www.submarinecablemap.com/#/landing-point/poti-georgia.

[32] The mainstream population, as well as the household access data, excludes transient labourers, which account for a significant proportion of residents in Qatar. According to data from ICTQatar, "transient labourers" make up 27 per cent of the overall population.

[33] http://qnbn.qa/qatar-vision-2030/.

[34] http://www.nbtc.go.th/wps/portal/NTC/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gTf3MX0wB3U09jtwBDA88QS-dQEwMfT1dzE6B8pFm8s7ujh4m5j4GBgZ-nqYGRS5iLn6erpYGBkxEB3eEg-_DrB8kb4ACOBvp-Hvm5qfoFuREGWSaOigCGMx-z/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfNE83RDVQRzVJQjdWMjBJVjg2RTZJSTA1NjQ!/?WCM_GLOBAL_CONTEXT=/wps/wcm/connect/library+ntc/internetsite/eng/en_interesting_articles/en_interesting_articles_detail/ae185900400633288ac5ceabcb3fbcab.

[35] http://www.telecompaper.com/news/thai-operators-reduce-prices-of-smartphone-data-plans--900198.

[36] http://www.telegeography.com/products/commsupdate/articles/2013/05/09/true-4g-launch-trumps-rivals-ais-claims-800000-users-at-official-2100mhz-launch-dtac-waits-until-june/?utm_source=CommsUpdate&utm_campaign=40c2385114-CommsUpdate+09+May+2013&utm_medium=email&utm_term=0_0688983330-40c2385114-8868625.

[37] See for example Sachs 2012, Henderson 2000, Gallup 1999 and Krugman 1998.

[38] Source: World Bank, see http://data.worldbank.org/indicator/NY.GNP.PCAP.CD.

[39] See: Czernich, N., Falck, O., Kretschmer, T. and Woessmann, L. (2009), Broadband Infrastructure and Economic Growth, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1516232; World Bank (2009), Information and Communication for Development: Extending Reach and Increasing Impact, http://go.worldbank.org/NATLOH7HV0. For an overview, see chapter 3 of Broadband Commission for Digital Development. Broadband: A Platform for Progress, 2011. Available at: http://www.broadbandcommission.org/net/broadband/Reports/Report_2.pdf. For a criticism see: Kenny, C. (2011), Overselling Broadband: A Critique of the Recommendations of the Broadband Commission for Digital Development, http://www.cgdev.org/files/1425798_file_Kenny_overselling_broadband_FINAL.pdf.

[40] http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/wsis/ungis_joint_statement_wsis_2013.pdf.

[41] A correlation analysis for a particular MDG indicator was performed if there is available data for at least one year between 2010 and 2012. The number of countries included in the analysis varies from 16 to 101 developing countries. The IDI 2011 was used as a reference, since it is the closest year to available MDG data.

[42] Broadband Commission. Transformative Solutions for 2015 and Beyond a Report of the Broadband Commission Task Force on Sustainable Development and http://www.broadbandcommission.org/Documents/Climate/BD-bbcomm-climate.pdf and The State of Broadband 2013 http://www.broadbandcommission.org/documents/bb-annualreport2013.pdf.

[43] The Pearson correlation coefficient (r) is a measure of the strength and direction of association that exists between two indicators. A positive correlation coefficient means that as the value of one indicator increases, the value of the other indicator increases; as one decreases the other decreases. A negative correlation coefficient indicates that as one indicator increases, the other decreases, and vice-versa. A statistically significant correlation means that the relationship between the two indicators does not happen by chance.

[44] Indicator where there is no attached code (such as this one) is not included in the official list of MDG indicators, but they are tracked by responsible agencies as additional indicators to help measure progress on the MDGs.

[45] http://www.un.org/millenniumgoals/pdf/Goal_6_fs.pdf.

[46] http://www.multidisciplinaryjournals.com/wp-content/uploads/2014/01/THE-ROLE-OF-INFORMATION-COMMUNICATION-TECHNOLOGY-ICT-.pdf.

[47] UNCTAD (2011), Measuring the Impacts of Information and Communication Technology for Development, http://unctad.org/en/docs/dtlstict2011d1_en.pdf.

Chapter 3. Regional IDI analysis

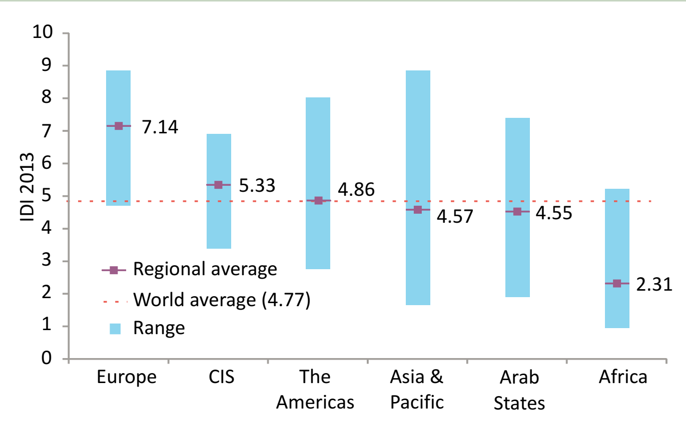
This chapter, which is based on the results of the IDI 2013 presented in Chapter 2 of this report, focuses specifically on analysis of the IDI by region. It presents IDI results separately for each of the six ITU Telecommunication Development Bureau (BDT) regions (Africa, Americas, Arab States, Asia and the Pacific, Commonwealth of Independent States (CIS) and Europe),[1] and a comparative analysis of the six regions.

The analysis of IDI 2013 results on the basis of the six ITU-BDT regions provides insights into differences in ICT development within and between regions. Europe displays by far the highest average IDI value of 7.14. The regional IDI values of the CIS (5.33), the Americas (4.86), Asia and the Pacific (4.57) and Arab States (4.55) are relatively close to each other. However, they fall either side of an important benchmark, as only the CIS and the Americas regional averages exceed the world average of 4.77, while Asia and the Pacific and Arab States remain below that value. Africa has by far the lowest regional IDI of 2.31, less than one-third the European average (Chart 3.1).

A look at the range (calculated by subtracting the lowest IDI value in the region from the highest value) and additional measures of disparity[2] yields information on differences in ICT development within regions and allows a comparative analysis of regional disparities (see Table 3.1). The range in IDI values, as well as the standard deviation (StDev) and coefficient of variation (CV), are highest by far in Asia and the Pacific, indicating that differences in ICT development are greatest in that region. The region includes both top performers (such as the Republic of Korea, Hong Kong (China) and Japan) and a number of least connected countries (LCCs) (including Afghanistan, Myanmar and Bangladesh). The CIS region has the smallest range in IDI values, which shows that the relatively small number of countries it comprises are relatively homogenous in terms of ICT development. The measures of disparity (StDev and CV) are lowest in Europe, which underlines that not only do European countries have a generally high level of ICT development, but also that differences between them are relatively small.

A comparison between 2012 and 2013 regional IDI values shows that the CIS and Arab States regional IDI averages increased the most within one year, and twice as much as in Africa, the region with the least improvements and lowest

Chart 3.1: IDI ranges and averages, by region and compared to world average, 2013



Note: Simple averages.
Source: ITU.

average in 2013. This indicates that Africa is not advancing enough in terms of ICT development to catch up with other, more advanced regions. Europe saw by far the biggest decrease in IDI range, and both the country at the top and that at the bottom of the regional ranking progressed from 2012 to 2013. Furthermore, Europe's standard deviation and coefficient of variation, which are lowest of all regions, further decreased. The range also slightly decreased in Asia and the Pacific, where the top and bottom-ranked countries both improved their values. While this region still has the most significant regional divide (in terms of range, StDev and CV), it is encouraging to see that the divide is narrowing. On the other hand, the CIS region, while remaining the region with the smallest range in IDI values, showed the highest increase in regional range. This is because the top-ranked CIS country improved its IDI value significantly more than the bottom-ranked country.

Table 3.2 presents a comparison of the global and regional rankings of the top five economies in each of the six regions, in order to provide further insights into the differences in ICT development. The European top five countries closely resemble the global top five – the Republic of Korea is the only non-European country among the global top five – which is dominated by Nordic countries. The top five economies from Asia and the Pacific also rank relatively high globally, all of them coming in the global top 20. In the Arab States and CIS regions, the top five countries are somewhat further apart, and rank lower globally, but are all still in the high and upper group of the IDI (see Chapter 2). The Americas' regional top five shows the highest disparity, reflecting the divide between the North American countries (United States and Canada), which are in the global top 25, and the Caribbean and Latin American countries, which rank somewhat lower. African countries rank quite low in the IDI and disparities between the top five are also quite considerable. Mauritius

Table 3.1: IDI by region, 2013 and 2012

Region	IDI 2013						IDI 2012						Difference 2012-2013		
	Max.	Min.	Range	Average value*	StDev	CV	Max.	Min.	Range	Average value*	StDev	CV	Range	Average value*	CV
Europe	8.86	4.72	4.14	7.14	1.04	14.55	8.78	4.42	4.35	6.98	1.09	15.60	-0.21	0.16	-1.05
CIS	6.89	3.40	3.49	5.33	1.13	21.26	6.45	3.27	3.18	5.07	1.06	20.91	0.31	0.26	0.35
The Americas	8.02	2.77	5.25	4.86	1.30	26.76	7.90	2.69	5.21	4.67	1.27	27.33	0.04	0.20	-0.56
Asia & Pacific	8.85	1.67	7.18	4.57	2.30	50.44	8.81	1.57	7.24	4.42	2.31	52.22	-0.06	0.15	-1.78
Arab States	7.40	1.91	5.49	4.55	1.80	39.51	7.22	1.90	5.32	4.30	1.64	38.10	0.17	0.25	1.41
Africa	5.22	0.96	4.26	2.31	1.08	46.68	4.96	0.93	4.02	2.18	1.02	46.53	0.24	0.13	0.15

Note: *Simple averages. StDev= Standard deviation, CV= Coefficient of variation.
Source: ITU.

Table 3.2: The top five economies in each region and their ranking in the global IDI, 2013

Regional IDI rank	Europe	Global IDI rank	Asia & Pacific	Global IDI rank	The Americas	Global IDI rank	Arab States	Global IDI rank	CIS	Global IDI rank	Africa	Global IDI rank
1	Denmark	1	Korea (Rep.)	2	United States	14	Bahrain	27	Belarus	38	Mauritius	70
2	Sweden	3	Hong Kong, China	9	Canada	23	United Arab Emirates	32	Russian Federation	42	Seychelles	75
3	Iceland	4	Japan	11	Barbados	35	Qatar	34	Kazakhstan	53	South Africa	90
4	United Kingdom	5	Australia	12	Uruguay	48	Saudi Arabia	47	Moldova	61	Cape Verde	93
5	Norway	6	Singapore	16	St. Kitts and Nevis	54	Oman	52	Azerbaijan	64	Botswana	104

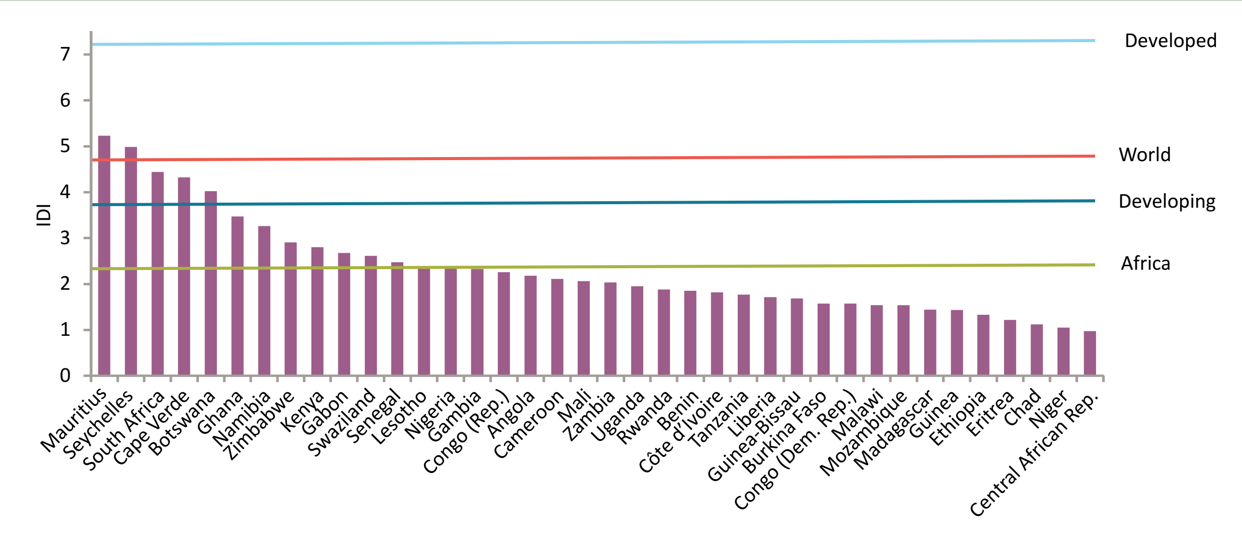
Source: ITU.

(70th position) and Seychelles (75th position) are the highest placed countries in the region.

3.1 Africa

The African regional IDI is the lowest of all six regions. Only two countries – Mauritius (5.22) and Seychelles (4.97) – lie above the global IDI average (4.77). South Africa, with an IDI value of 4.42, falls just below the global average, but together with Cape Verde and Botswana achieves a higher value than the developing-country average (3.84) in the IDI 2013. Mauritius, Seychelles, South Africa and Cape Verde are the only African countries in the top 100 of the IDI 2013. Nigeria, the region's most populous country, ranks 133rd in the IDI 2013, with an IDI value of 2.35 (see Chart 3.2). Three-quarters – or 29 out of 38 African countries – are considered to be LCCs. The bottom eleven of the IDI 2013 are all African countries, including the Central African Republic, the only country with an IDI value of less than one. This underlines that there is a severe divide between the regions and

Chart 3.2: IDI values compared with the global, regional and developing/developed-country averages, Africa, 2013



Source: ITU.

that the large majority of Africans still need to develop their information societies.

At the same time, it is very encouraging to see that a number of African countries are among the most dynamic in the IDI 2013. Cape Verde stands out with an increase in IDI rank from 104th in 2012 to 94th in 2013. The country showed great progress on both the access and use sub-indices of the IDI. Gambia and Seychelles also improved on the access sub-index. Significant increases in wireless-broadband penetration pushed Burkina Faso and the Republic of the Congo up the use sub-index. The largest group of countries (14 out of 38), however, did not change their global rank from 2012 to 2013 (Table 3.3).

By end 2013, mobile-cellular penetration had reached 66 per cent in Africa and growth continues to be stronger than in other regions. With only ten out of 38 African countries

Table 3.3: IDI – Africa

Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
Mauritius	1	70	5.22	72	4.96	2
Seychelles	2	75	4.97	76	4.70	1
South Africa	3	90	4.42	89	4.19	-1
Cape Verde	4	93	4.30	104	3.86	11
Botswana	5	104	4.01	100	3.94	-4
Ghana	6	113	3.46	115	3.29	2
Namibia	7	117	3.24	118	3.08	1
Zimbabwe	8	121	2.89	123	2.68	2
Kenya	9	124	2.79	124	2.62	0
Gabon	10	126	2.66	125	2.61	-1
Swaziland	11	128	2.60	128	2.43	0
Senegal	12	130	2.46	133	2.20	3
Lesotho	13	132	2.36	131	2.22	-1
Nigeria	14	133	2.35	135	2.14	2
Gambia	15	135	2.31	136	2.12	1
Congo (Rep.)	16	137	2.24	137	2.09	0
Angola	17	139	2.17	139	2.06	0
Cameroon	18	140	2.10	142	1.98	2
Mali	19	143	2.04	147	1.86	4
Zambia	20	144	2.02	143	1.97	-1
Uganda	21	146	1.94	144	1.90	-2
Rwanda	22	148	1.86	151	1.74	3
Benin	23	149	1.84	149	1.75	0
Côte d'Ivoire	24	151	1.80	150	1.74	-1
Tanzania	25	152	1.76	152	1.72	0
Liberia	26	153	1.70	154	1.57	1
Guinea-Bissau	27	154	1.67	153	1.60	-1
Burkina Faso	28	156	1.56	160	1.35	4
Congo (Dem. Rep.)	29	157	1.56	157	1.47	0
Malawi	30	158	1.52	156	1.50	-2
Mozambique	31	159	1.52	159	1.40	0
Madagascar	32	160	1.42	158	1.43	-2
Guinea	33	161	1.42	161	1.31	0
Ethiopia	34	162	1.31	162	1.24	0
Eritrea	35	163	1.20	163	1.18	0
Chad	36	164	1.11	164	1.09	0
Niger	37	165	1.03	165	0.97	0
Central African Rep.	38	166	0.96	166	0.93	0
Average*			**2.31**		**2.18**	

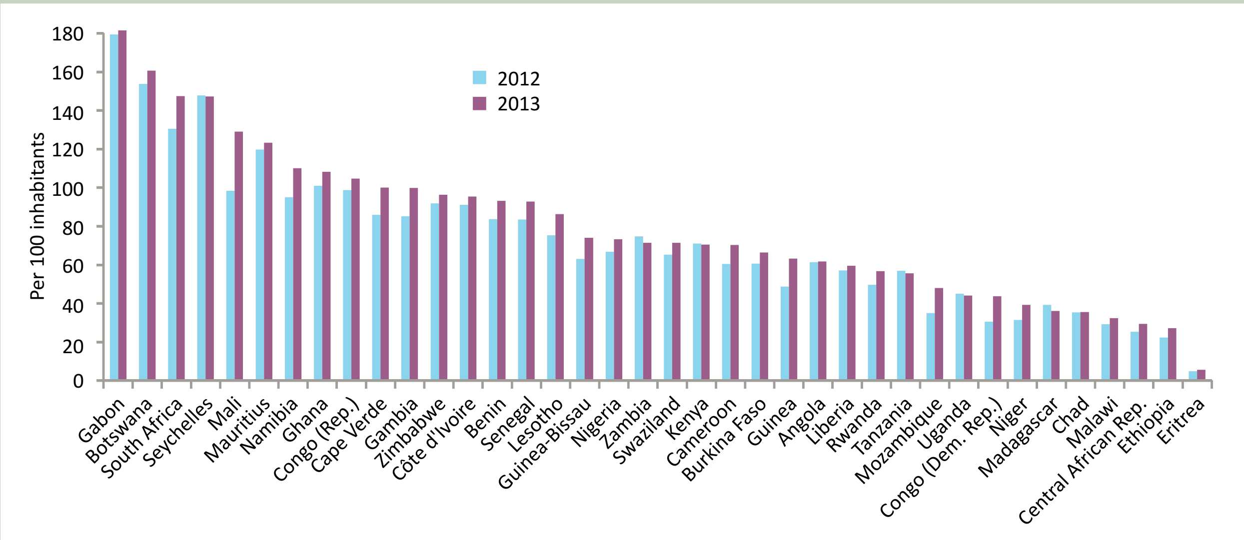
Note: *Simple averages.
Source: ITU.

reaching more than 100 per cent mobile-cellular penetration, there is certainly still room for growth in the mobile markets. Improving coverage is particularly challenging in vast rural areas and where the reach of basic infrastructure, including electricity, is limited. Eritrea has the lowest mobile-cellular penetration in the world, at 6 per cent. Penetration levels are also extremely low, at below 30 per cent, in Ethiopia and the Central African Republic. Both Eritrea and Ethiopia have one of the last remaining monopolies in the mobile market. On the other hand, Gambia and Namibia both exceeded 100 per cent penetration by end 2013. Significant increases in mobile-cellular penetration from 2012 to 2013 were also registered in Guinea (from 49 per cent to 63 per cent), Mozambique (from 35 per cent to 48 per cent) and the Republic of the Congo (from 31 per cent to 44 per cent) (see Chart 3.3).

A lack of international Internet bandwidth is seriously hampering ICT development in Africa. Although the region has been connected to a number of international submarine cables along its East and West coasts, African countries are lacking international Internet connectivity. Countries including the Central African Republic, Republic of the Congo, Madagascar, Congo (Dem. Rep.), Chad and Nigeria have less than 1 000 bit/s of international Internet bandwidth per Internet user at their disposal. Being connected to four international submarine cable systems, Kenya has the highest amount of international Internet bandwidth, both in total and per Internet user, at 50 000 bit/s per user (see MIS 2013). Seychelles (24 000 bit/s) and Mauritius (24 500 bit/s) also have relatively high amounts of bandwidth per Internet user, partly because of their very small populations and hence small number of Internet users.

The divide between Africa and the world becomes most visible when looking at ICT household penetration: by end 2013, on average, less than 10 per cent of households in the region had access to the Internet at home, compared to the global average of 40 per cent and the developing-country average of 28 per cent. Looking at the country level, only four out of a total of 38 countries in Africa record more than 30 per cent of households with Internet access. They are: Seychelles (51 per cent), Mauritius (44.5 per cent), South Africa (39 per cent) and

Chart 3.3: Mobile-cellular subscriptions per 100 inhabitants, 2012 and 2013, Africa



Note: Gabon mobile-cellular penetration is 215 per cent by end 2013.
Source: ITU World Telecommunication/ICT Indicators database.

Ghana (32 per cent). Twenty countries have a penetration of less than 5 per cent, including eight countries in which less than 2 per cent of households have Internet access.

The most dynamic indicator in the region, as at the global level, is without doubt wireless broadband. While 3G networks are continuing to be built and expanded across the region, numerous countries saw some important increases in penetration from 2012 to 2013. In Burkina Faso, 3G was finally launched in 2013, reaching a penetration of 9 per cent by end 2013. Cape Verde attained the second highest penetration in the region, at 43 per cent (after Botswana with 74 per cent) following an expansion of network coverage throughout the archipelago.[3] Large-scale infrastructure roll-out also helped to increase uptake of wireless broadband in Nigeria[4] (from 5 per cent in 2012 to 10 per cent in 2013). Data from South African operators show that not only is wireless-broadband penetration reaching higher levels – 29per cent by end 2013 – but customers are consuming more data, indicating an increase in the intensity of usage. MTN reported a growth of 63 per cent in data volumes in the first half of 2013 and Vodacom reported that on average users were generating 75 per cent more data traffic per device than a year ago.[5] Wireless broadband is of particular importance in the region because fixed-broadband infrastructure is lacking. The vast majority of African countries – 32 out of 38 – had a fixed-broadband penetration of less than 1 per cent by end 2013. In fact, only two countries, Seychelles (13 per cent) and Mauritius (12.5 per cent) have notable numbers of fixed-broadband subscriptions.

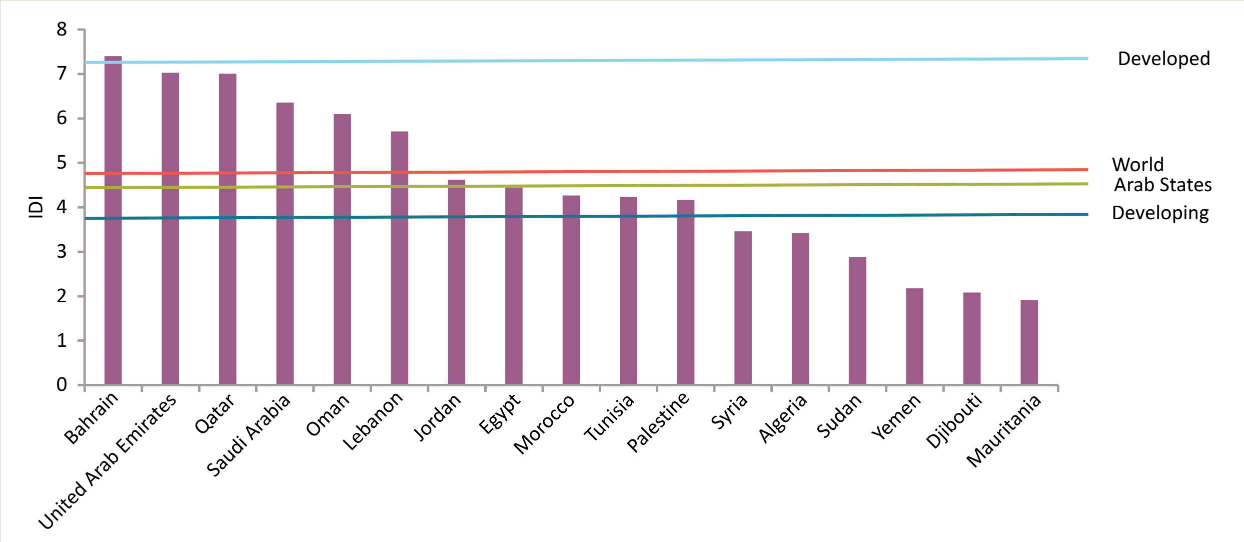
Africa was home to 150 million Internet users by end 2013. This corresponds to around 17 per cent of the population in the region. A lack of ICT infrastructure and high service costs (see Chapter 4) are some of the main obstacles preventing more people from going online. However, in a number of African countries, a relatively high proportion of the population is online. These include Seychelles (50 per cent), South Africa (49 per cent), Mauritius and Kenya (both 39 per cent) and Cape Verde and Nigeria (both 38 per cent).

3.2 Arab States

The top five countries in the Arab States in terms of ICT development – Bahrain, United Arab Emirates, Qatar, Saudi Arabia and Oman – are all oil-rich, high-income economies and are part of the Cooperation Council for the Arab States of the Gulf (GCC). They exhibit IDI values of six and above and are in the top 60 in the global rankings. The performance of GCC countries underlines the link between IDI and GNI per capita, with high-income countries attaining higher IDI values. Those countries, as well as the regional number six Lebanon, all exceed the global average IDI value. At the other end of the scale, there are a number of countries in the Arab States region which have a much lower level of development, namely Syria, Algeria, Sudan, Yemen, Djibouti and Mauritania, with IDI values below the developing-country average (see Chart 3.4). The latter three are considered as LCCs (see Box 2.2). Egypt, which is by far the region's most populous country with around 82 million inhabitants, ranks in eight position regionally, with an IDI value of 4.45, just below the regional average (4.55).

The countries at the top recorded the largest improvements in IDI ranking from 2012 to 2013; the United Arab Emirates (+14 ranks), Qatar (+8 ranks) and Oman (+9 ranks), in particular, moved up considerably. The United Arab Emirates overtook Qatar as the second highest ranked Arab country in 2013. All top six countries in the region managed to improve their global ranking from 2012 to 2013. However, all the remaining Arab countries remained at the same position as in 2012 or went down in international comparison, most notably Palestine, which dropped from 95th in 2012 to 100th place in 2013, as well as Morocco and Jordan, which lost four and three places, respectively, in relation to 2012. Finally, the country at the very bottom of the

Chart 3.4: IDI values compared with the global, regional and developing/developed-country averages, Arab States, 2013



Source: ITU.

regional rankings – Mauritania – managed only a very slight increase in its IDI value, and fell two places to 147th position globally (Table 3.4). This indicates that the Arab States with a lower IDI are not keeping up with ICT developments, while the top countries in the region are catching up with the IDI top performers.

In the vast majority of Arab States, mobile-cellular penetration has reached very high levels of 100 per cent and above. Only Djibouti (30 per cent) and Syria (56 per cent) still had a very low mobile-cellular penetration in 2013. The region's predominantly prepaid markets (the share of prepaid subscriptions was reported to be 90 per cent or more in the majority of countries) are characterized by a high level of competition and high levels of multi-SIM ownership (GSMA and Deloitte, 2013). Furthermore, the very high mobile-cellular penetration rates reached in the GCC countries are driven by large transient worker and expatriate populations. Data from household surveys show that the actual number of people using a mobile-cellular phone is much lower than the number of subscriptions. In Tunisia, 72 per cent of individuals were using a mobile-cellular phone, compared with a mobile-cellular penetration of 118 per cent in 2012. Egypt reported a penetration of 120 per cent by end 2012, compared with 74 per cent of individuals using a mobile-cellular phone. Fixed-telephone penetration is extremely low in the Arab States region, with a regional average of 9 per cent in 2013. This further highlights the importance of mobile networks in the region.

The Arab States region and in particular the GCC countries are well-connected to submarine Internet cables. The United Arab Emirates boasts the highest amount of international Internet bandwidth per Internet user (around 52 000 bit/s per user) in the region. Furthermore, the country almost doubled its Internet bandwidth between 2012 and 2013. Oman, too, saw a significant increase in total international Internet bandwidth, up from 17 792 Mbit/s in 2012 to 82 010 Mbit/s in 2013. In 2013, the Europe-Persia Express Gateway that connects the United Arab Emirates and Oman to Germany via the Islamic Republic of Iran went live, increasing the region's international Internet connectivity.[6] Furthermore, the Gulf Bridge International (GBI) system completed its "North Route" terrestrial link in 2013, which connects the Gulf region to Europe.[7]

Table 3.4: IDI – Arab States

Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
Bahrain	1	27	7.40	28	7.22	1
United Arab Emirates	2	32	7.03	46	6.27	14
Qatar	3	34	7.01	42	6.46	8
Saudi Arabia	4	47	6.36	50	6.01	3
Oman	5	52	6.10	61	5.43	9
Lebanon	6	62	5.71	64	5.32	2
Jordan	7	87	4.62	84	4.48	-3
Egypt	8	89	4.45	87	4.28	-2
Morocco	9	96	4.27	92	4.09	-4
Tunisia	10	99	4.23	96	4.07	-3
Palestine	11	100	4.16	95	4.07	-5
Syria	12	112	3.46	112	3.39	0
Algeria	13	114	3.42	114	3.30	0
Sudan	14	122	2.88	121	2.69	-1
Yemen	15	138	2.18	138	2.07	0
Djibouti	16	141	2.08	140	2.01	-1
Mauritania	17	147	1.91	145	1.90	-2
Average*			**4.55**		**4.30**	

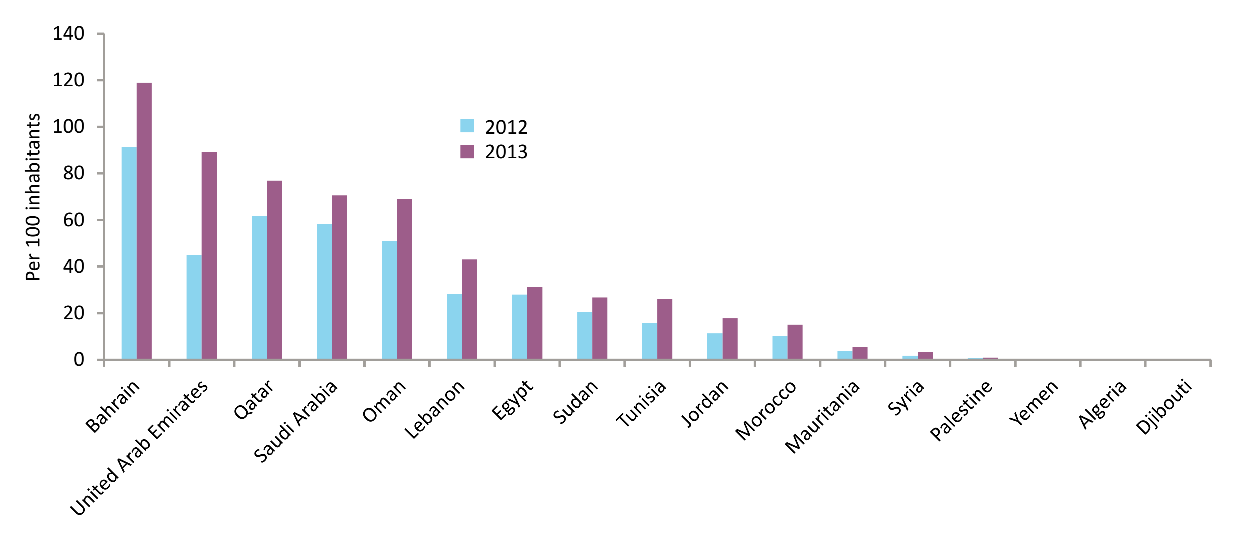
Note: *Simple averages.
Source: ITU.

In terms of ICT household connectivity, Qatar stands out not only in the region but in international comparison with more than 96 per cent of households with Internet access and with a computer. The remaining GCC states all reach high household ICT penetration rates of 70 per cent and above. Income disparities in the region are also reflected when it comes to the number of households with Internet access: in Yemen and Mauritania, less than 5 per cent of households have Internet access. Morocco was able to connect a significant number of households to the Internet in 2013, penetration increasing from 39 per cent in 2012 to 46 per cent in 2013. Oman saw high increases in terms of both households with Internet access and households with a computer as a result of the National PC Initiative. Through this initiative, eligible families (those benefiting from the social welfare programme with at least one child enrolled in primary school, secondary school or higher education studies) in Oman are offered one free computer per student. Furthermore, Omantel provides discounted broadband Internet offers for eligible customers.[8]

Wireless-broadband penetration levels vary considerably across the region. The number of subscriptions exceeds the population in Bahrain, the United Arab Emirates has a penetration of 89 per cent, and both Qatar and Saudi Arabia exceed 70 per cent penetration. While the Gulf States are extending and upgrading their mobile-broadband networks – in Qatar LTE is available throughout the entire country[9] – Algeria and Djibouti had not yet launched mobile-broadband services in 2013 (see Chart 3.5). However, there is some room for optimism, as 3G licences were finally awarded to three Algerian operators by end 2013.[10] Penetration is also extremely low in Yemen (0.3 per cent), Palestine (1 per cent) and Syria (3 per cent). Those discrepancies underline the different levels of economic development within the Arab States region and also reflect the fact that mobile-broadband services in the lower-income countries are much less affordable than in the high-income Arab States (see Chapter 3).

Fixed-broadband penetration is generally low in the Arab States, with a regional average of just 3 per cent by end 2013. Mobile (voice and

Chart 3.5: Wireless-broadband subscriptions per 100 inhabitants, Arab States, 2012 and 2013



Source: ITU World Telecommunication/ICT Indicators database.

broadband) services are much more popular in the region. The majority of Arab States have a fixed-broadband penetration of less than 5 per cent, with Syria, Yemen, Mauritania and Sudan displaying less than 2 per cent penetration. Only Bahrain (13 per cent) and the United Arab Emirates (13 per cent) reach double-digit rates.

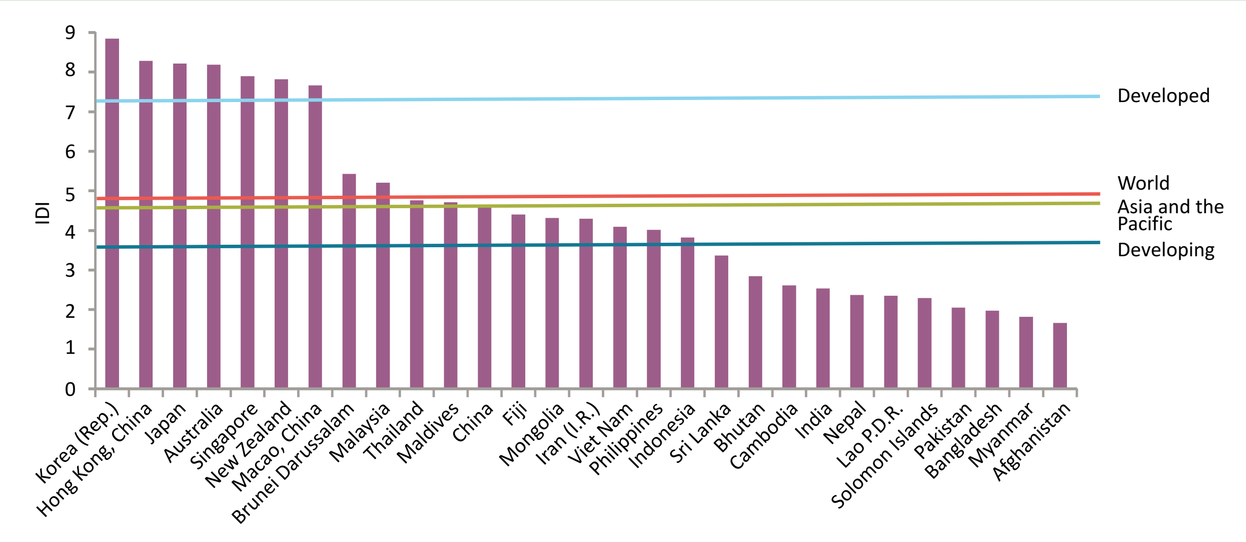
Around 137 million people in the Arab States were online by end 2013. The countries where the biggest proportions of the population are online are Bahrain (90 per cent), United Arab Emirates (88 per cent) and Qatar (85 per cent).[11] Egypt and Morocco, which have a much larger number of inhabitants than the Gulf States, also reach Internet user penetration rates of 50 and 56 per cent, respectively. On the other hand, in the LCCs Mauritania and Djibouti, less than 10 per cent of the population are online.

3.3 Asia and the Pacific

Asia and the Pacific is indisputably the most diverse region in terms of ICT development, reflecting the stark differences in economic development throughout the region. At the top of the regional ranking stand a group of ICT champions – the Republic of Korea, Hong Kong (China), Japan, Australia, Singapore, New Zealand and Macao (China) – that all exceed the developed-country average and rank in the top 25 on the global IDI. There is a visible gap between the regional number seven – Macao (China), with an IDI of 7.66 – and the regional number eight – Brunei Darussalam with an IDI of 5.43. Brunei Darussalam and Malaysia still achieve an IDI value that is higher than the global average (4.77). All remaining 20 countries lie below the IDI global average, and12 of them fall short of the developing-country average (3.84). Most of these countries make up the Asia-Pacific's LCCs: Afghanistan, Bangladesh, Cambodia, India, Lao P.D.R., Myanmar, Nepal, Pakistan and Solomon Islands. The world's most populous country, China, ranks in 12th position in the region, with an IDI value of 4.64 (Chart 3.6).

The largest group of countries from Asia and the Pacific saw a decrease in global rank from 2012 to 2013. Malaysia moved down the most in international comparison, from 66th to 71st

Chart 3.6: IDI values compared with the global, regional and developing/developed-country averages, Asia and the Pacific, 2013



Source: ITU.

position in the IDI 2013. Lao P.D.R. and Solomon Islands lost four ranks on the 2013 IDI in relation to the previous year. At the same time, Fiji (+12 ranks) and Thailand (+10 ranks) are among the most dynamic countries of the IDI 2013. In both cases, a significant increase in wireless-broadband penetration is responsible for the boost. Countries such as Bhutan, Nepal and the Islamic Republic of Iran also made good progress on the global IDI (see Table 3.5).

More than half of all Asia and the Pacific countries have reached a mobile-cellular penetration of 100 per cent or above by end 2013. A number of countries with penetration rates below 100 per cent nonetheless saw significant increases from 2012 to 2013. Although Myanmar stands out as having one of the lowest mobile-cellular penetrations worldwide, it almost doubled its rate from 7 per cent in 2012 to 13 per cent in 2013. Nepal achieved a mobile-cellular penetration rate of 71 per cent in 2013, up from 60 per cent in 2012. In China, more than 100 million new mobile-cellular subscriptions were added in 2013, taking the penetration rate up to 89 per cent.

Hong Kong (China) has the highest amount of international Internet bandwidth in the region, and indeed one of the highest volumes in the world, at close to 9.5 million Mbit/s[12] by end 2013. As a regional hub and international financial centre, Hong Kong (China) relies upon a secure and low-latency Internet connection, and the telecommunication regulator has made the attraction of international submarine cables a policy priority[13] (see MIS 2013, Box 2.10). In 2013, the Southeast Asia Japan Cable (SJC) became available for service, connecting Japan with Hong Kong (China), China, the Philippines, Thailand, Brunei Darussalam and Singapore.[14] With the landing of the SJC cable system, international Internet connectivity was boosted in these countries. Additional international Internet bandwidth is of particular importance for sustaining ICT growth and ensuring Internet connectivity for an increasing number of users in populous countries such as China (with an estimated 600 million Internet users) and the Philippines (with an estimated 36.5 million Internet users by end 2013). Within the Philippines, domestic connectivity was further improved by connecting some of the archipelago's islands through the Boracay-Palawan Submarine Cable System, which went live in the summer of 2013.[15] Regional Internet connectivity was further enhanced when the Tonga Cable, connecting Fiji and Tonga, and the Guam Okinawa Kyushu Incheon (GOKI) cable, connecting Japan with Guam, went live in 2013. On the other hand, a number of countries in Asia and the Pacific have very low levels of international Internet connectivity; these include, in particular, the landlocked and least connected countries Afghanistan, Bhutan and Nepal, with less than 4 000 bit/s per Internet user.

The regional divide in the Asia-Pacific region becomes very visible when comparing the ICT connectivity of households throughout the region. While no more than 5 per cent of households in Afghanistan, Bangladesh, Lao P.D.R., Myanmar, Nepal and Solomon Islands have Internet access at home, virtually all households in the Republic of Korea (98 per cent) enjoy this facility. In Japan and Singapore, 86 per cent of households have Internet access, and Macao (China) registered 83 per cent of households with Internet access by end 2013. Thailand made good progress in connecting more of the kingdom's households with ICTs. Penetration increased from 17.5 per cent of households with Internet access in 2012 to 23 per cent by end 2013. By end 2013, 29 per cent of households had a computer. Data from the annual ICT household survey show that, since 2008, computers have replaced telephones as the most commonly available ICT device in Thai homes. Furthermore, the majority of households

Table 3.5: IDI – Asia and the Pacific

Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
Korea (Rep.)	1	2	8.85	1	8.81	-1
Hong Kong, China	2	9	8.28	11	8.08	2
Japan	3	11	8.22	10	8.15	-1
Australia	4	12	8.18	12	8.03	0
Singapore	5	16	7.90	15	7.85	-1
New Zealand	6	19	7.82	19	7.62	0
Macao, China	7	22	7.66	20	7.59	-2
Brunei Darussalam	8	66	5.43	63	5.36	-3
Malaysia	9	71	5.20	66	5.18	-5
Thailand	10	81	4.76	91	4.09	10
Maldives	11	85	4.71	82	4.50	-3
China	12	86	4.64	86	4.39	0
Fiji	13	91	4.40	103	3.90	12
Mongolia	14	92	4.32	90	4.19	-2
Iran (I.R.)	15	94	4.29	97	4.02	3
Viet Nam	16	101	4.09	99	3.94	-2
Philippines	17	103	4.02	102	3.91	-1
Indonesia	18	106	3.83	106	3.70	0
Sri Lanka	19	116	3.36	113	3.31	-3
Bhutan	20	123	2.85	126	2.58	3
Cambodia	21	127	2.61	127	2.54	0
India	22	129	2.53	129	2.42	0
Nepal	23	131	2.37	134	2.20	3
Lao P.D.R.	24	134	2.35	130	2.25	-4
Solomon Islands	25	136	2.29	132	2.22	-4
Pakistan	26	142	2.05	141	2.01	-1
Bangladesh	27	145	1.97	146	1.90	1
Myanmar	28	150	1.82	148	1.75	-2
Afghanistan	29	155	1.67	155	1.57	0
Average*			**4.57**		**4.42**	

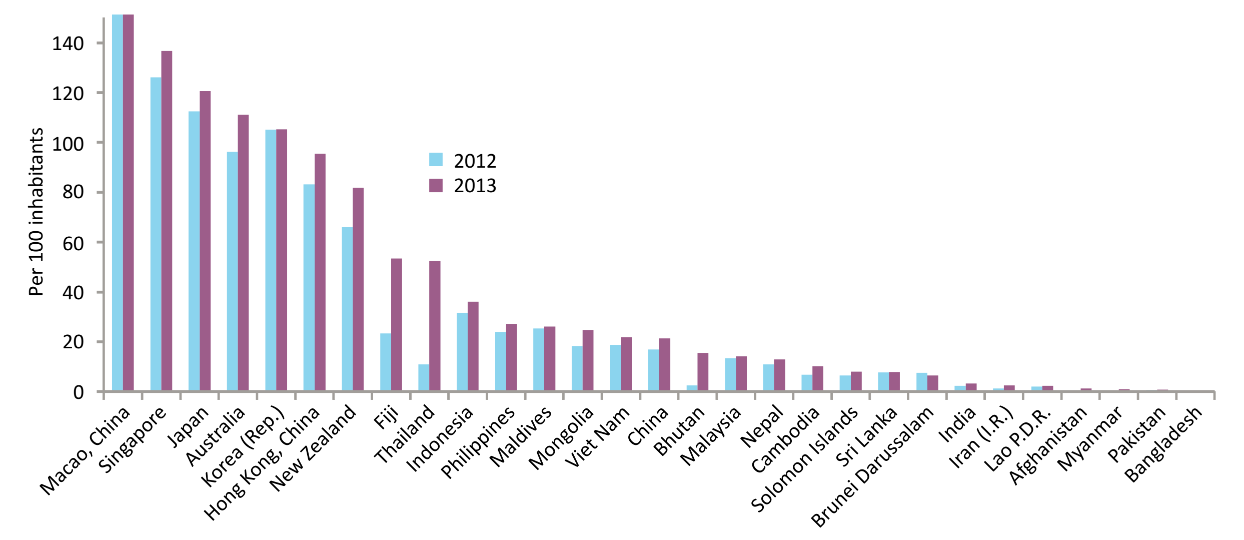
Note: *Simple averages.
Source: ITU.

with Internet access have a fixed-broadband connection.[16]

Given its large population size, Asia and the Pacific has the highest number of mobile-broadband subscriptions, at just over 750 million by end 2013. Growth continues to be very dynamic throughout the region, and in particular in those countries that had a relatively low penetration in 2012 (see Chart 3.7). Bhutan increased its penetration rates more than sixfold, from only 2.5 per cent (in 2012) to 16 per cent (in 2013). In Thailand, where 3G was launched very late, wireless-broadband penetration went up from 11 per cent in 2012 to more than 50 per cent in 2013. Both countries feature among the most dynamic of the IDI 2013, mostly because of the considerable, above-average increases in wireless-broadband penetration. While some economies, including Australia, Japan, Macao (China), Republic of Korea and Singapore, had already reached very high levels of penetration, other countries in the region still lag behind. Wireless-broadband penetration was less than 5 per cent by end 2013 in Afghanistan, India, Islamic Republic of Iran, Lao P.D.R. and Myanmar. All of these – with the exception of the Islamic Republic of Iran – are LCCs that could greatly benefit from the extension of wireless broadband to connect more people with ICTs.

By end 2013, fixed-broadband penetration stood at 38 per cent in the Republic of Korea, one of the highest values attained worldwide. This underlines the country's high rank on the IDI 2013, with an exceptionally well-developed ICT infrastructure and high levels of ICT uptake and usage. Hong Kong (China), New Zealand, Japan, Macao (China), Singapore and Australia also registered high levels of between 25 and 30 per cent fixed-broadband penetration. China stands out for a relatively high fixed-broadband penetration of 14 per cent, above the global average of 9 per cent. In 2013 alone, close to 14 million new fixed-broadband subscriptions were added, although numbers of additions in absolute terms have been declining since 2012. Penetration is expected to regain momentum in 2014, with China Mobile entering the fixed-line market.[17] China's broadband strategy, published in August 2013, underlines the importance of broadband as a "strategic public infrastructure for China's economic and social development in the new age". The plan targets a fixed-broadband

Chart: 3.7: Wireless-broadband penetration, Asia and the Pacific, 2012 and 2013



Note: Macao (China) penetration of 303 per cent by end 2013 and 289 per cent by end 2012.
Source: ITU World Telecommunication/ICT Indicators database.

household penetration of 50 per cent and a 3G penetration rate of 32.5 per cent by 2015.[18]

There were 1.2 billion people from the Asia and the Pacific region online by end 2013. This includes around 600 million Chinese and 200 million Indian Internet users. Comparing the two, the proportion of the population using the Internet is much higher in China (44 per cent) than India (15 per cent). India has one of the lowest rates in the region (and globally): only Afghanistan, Bangladesh, Cambodia, Lao P.D.R., Myanmar, Nepal, Pakistan and Solomon Islands recorded a lower proportion of Internet users. Japan (86 per cent), the Republic of Korea (85 per cent) and Australia and New Zealand (both 83 per cent) exhibit the highest rates in the Asia and the Pacific region.

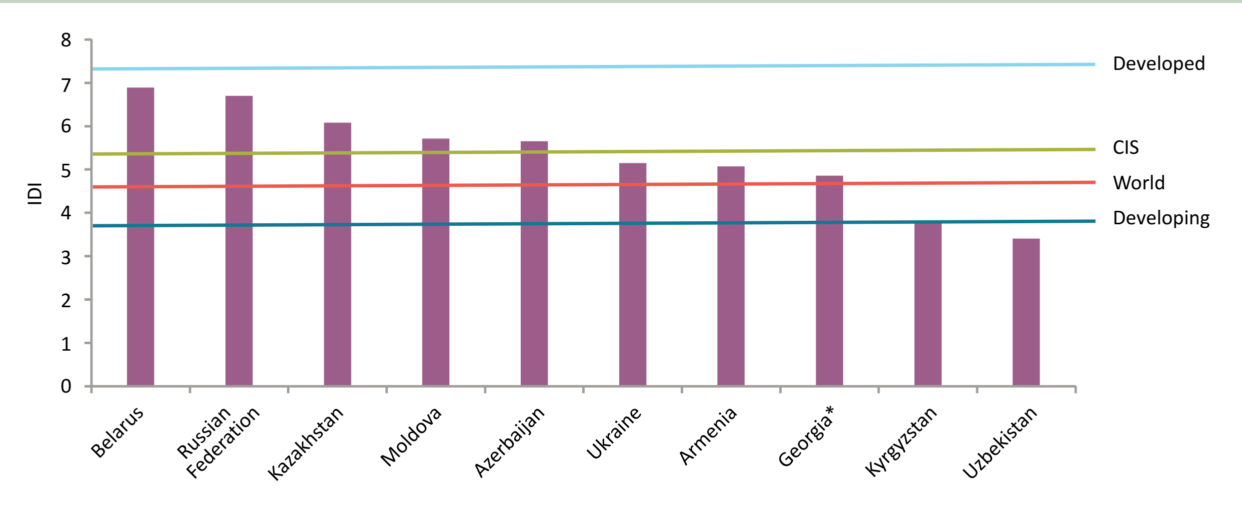
3.4 Commonwealth of Independent States

Belarus is the highest ranked country from the Commonwealth of Independent States (CIS), with an IDI value of 6.89, followed by the Russian Federation, with an IDI value of 6.70. All CIS countries remain below the developed-country average (7.20).[19] With the exception of Kyrgyzstan and Uzbekistan, however, they are all above the global average of 4.77. While Kyrgyzstan lies above the developing-country average (3.84), Uzbekistan remains below (see Chart 3.8).

The CIS region shows the most important increase in IDI value from 2012 to 2013. Two countries – Belarus and Georgia – stand out in terms of improvement in their global IDI rankings from 2012 to 2013. Belarus climbed from 43rd place in 2012 to 38th in 2013, overtaking the Russian Federation as the country with the highest IDI in the region. Georgia went up five places to 78th position in the IDI 2013. Uzbekistan, which lies at the bottom of the regional ranking, and Azerbaijan improved their position in the global IDI by one rank from 2012 to 2013. All other CIS countries fell by one position in the global IDI, with the exception of Ukraine, which went down two places (see Table 3.6).

By end 2013, the CIS region had the highest mobile-cellular penetration of all regions, at

Chart 3.8: IDI values compared with the global, regional and developing/developed-country averages, CIS, 2013



Note: Until 2009, the CIS region included the above countries. Georgia exited the Commonwealth on August 18, 2009, but is included in this report.
Source: ITU.

Table 3.6: IDI – CIS

Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
Belarus	1	38	6.89	43	6.45	5
Russian Federation	2	42	6.70	41	6.48	-1
Kazakhstan	3	53	6.08	53	5.80	0
Moldova	4	61	5.72	60	5.44	-1
Azerbaijan	5	64	5.65	65	5.22	1
Ukraine	6	73	5.15	71	4.97	-2
Armenia	7	74	5.08	73	4.89	-1
Georgia**	8	78	4.86	83	4.48	5
Kyrgyzstan	9	108	3.78	107	3.69	-1
Uzbekistan	10	115	3.40	116	3.27	1
Average*			**5.33**		**5.07**	

Note: *Simple averages. ** Until 2009, the CIS region included the above countries. Georgia exited the Commonwealth on August 18, 2009, but is included in this report.
Source: ITU.

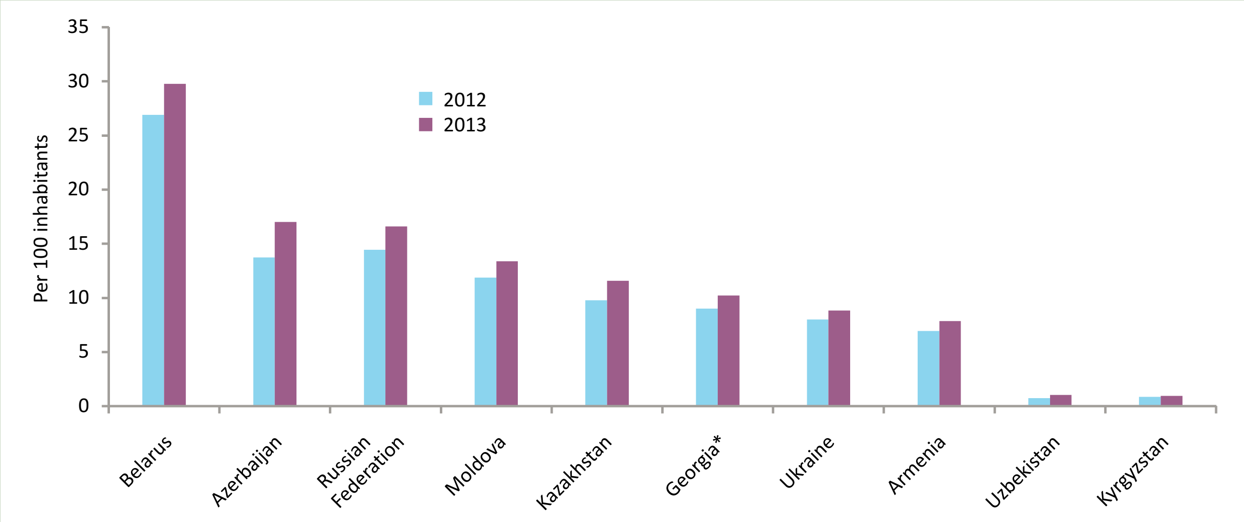
137 per cent. Penetration well exceeded the number of inhabitants in all CIS countries with the exception of Uzbekistan. The mobile markets in the CIS are predominately prepaid, with typically high rates of multi-SIM ownership. Furthermore, markets are very competitive, with a relatively high number of mobile operators. In the majority of CIS countries, at least four mobile operators are active in the market. The Russian Federation, for example, has one of the most de-concentrated mobile markets globally, with three national operators and several regional operators competing for 143 million potential customers.

Data from household surveys collected in a number of CIS countries underline that mobile-cellular penetration, measured as the number of mobile-cellular subscriptions, can give no more than an indication of the actual number of subscribers (i.e. a mobile-cellular penetration of above 100 per cent does not mean that every inhabitant has a mobile-cellular subscriptions). For instance, whereas mobile-cellular penetration in Ukraine stood at 130 per cent by end 2012, 9 per cent of households did not have access to a mobile-cellular telephone. In Georgia, 18 per cent of households did not have access to a mobile-cellular telephone in 2012, even though mobile-cellular penetration stood at 108 per cent.

The Russian Federation had the highest proportion of households with Internet access and households with a computer in the region by end 2013, at 67 per cent and 70 per cent, respectively. In Azerbaijan, Belarus and Kazakhstan, more than half of households have Internet access at home and a computer. Kyrgyzstan and Uzbekistan display a very low ICT household penetration, with less than 10 per cent of households in the country having access to the Internet. Total international Internet bandwidth is by far highest in the Russian Federation, which is connected through a number of terrestrial links to both Europe and the Asia-Pacific region.[20] However, given its large population size, in terms of bandwidth per Internet user the country is below most other CIS countries. International Internet bandwidth per Internet user is highest in Moldova (115 845 bit/s per user), followed by Belarus (94 797 bit/s per user) and Georgia (82 094 bit/s per user). Kyrgyzstan and Uzbekistan have very limited bandwidth, which hampers Internet connectivity and hence further development of the ICT sector in those countries.

By end 2013, half of CIS countries had reached a wireless-broadband penetration of more than 45 per cent. The Russian Federation boasted the highest penetration (60 per cent), followed by Kazakhstan (56.5 per cent). The Russian Federation was one of the first countries in the region to launch 3G services in 2007.[21] Since then, operators have expanded their mobile-broadband networks beyond the main cities

Chart 3.9: Fixed (wired)-broadband subscriptions per 100 inhabitants, CIS, 2012 and 2013



Note: Until 2009, the CIS region included the above countries. Georgia exited the Commonwealth on August 18, 2009, but is included in this report.
Source: ITU World Telecommunication/ICT Indicators database.

to provide further Internet connectivity. LTE services were launched in the Russian Federation in 2012.[22] The highest growth in wireless-broadband penetration from 2012 to 2013 took place in Georgia – from 9 per cent in 2012 to 17 per cent in 2013 – placing it among the most dynamic countries in the region and indeed on the global IDI 2013. Ukraine has the lowest penetration in the region, at 7 per cent by end 2013. The slow growth in wireless-broadband penetration in Ukraine explains why the country is falling back in international comparison.

Belarus has by far the highest fixed-broadband penetration in the region, at 30 per cent, which is consistent with the country's high fixed-telephone penetration of 48 per cent by end 2013. Penetration is also relatively high (17 per cent) in Azerbaijan and the Russian Federation. The Russian fixed-broadband-market is one of the most de-concentrated in the world, and the country has the most affordable entry-level fixed-broadband prices in the CIS, at 0.6 per cent of GNI per capita (see Chapter 4). Uzbekistan and Kyrgyzstan, the two bottom-ranked countries in the region, both have very low fixed-broadband penetration rates of around 1 per cent (see Chart 3.9).

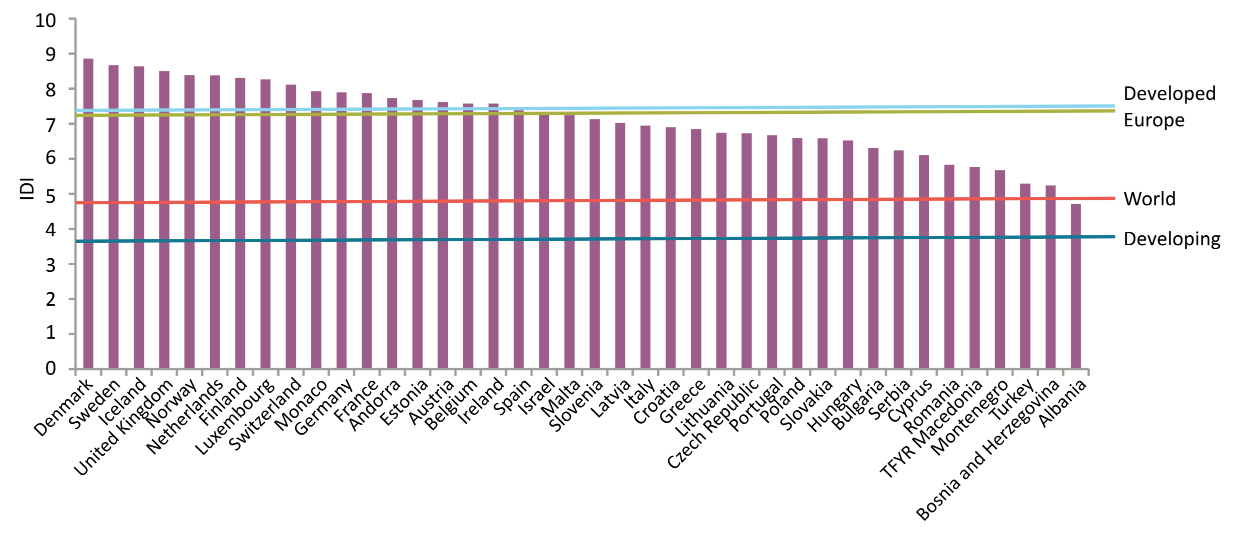
3.5 Europe

All countries in the European region, with the exception of Albania, exceed the global average IDI of 4.77. Moreover, half of countries in the region have an IDI value that is higher than the developed-country average of 7.20 (Chart 3.10).

While the region in general has attained high levels of ICT development, there is a divide within Europe between the lower ranking Eastern and Southern European countries, on the one hand, and the Western, in particular Nordic, European countries that rank at the top of the regional and global IDI, on the other. The region's most populous country, Germany, ranks in 11th position on the IDI 2013, with a very high IDI value of 7.90. Turkey, the country with the second highest population in Europe, ranks in 68th position in the IDI 2013.

The largest group of European countries decreased in global IDI rank from 2012 to 2013. This trend can be observed for those countries that already have a very high level of ICT development (such as the Netherlands,

Chart 3.10: IDI values compared with the global, regional and developing/developed-country averages, Europe, 2013



Source: ITU.

Luxembourg, France and Austria) and are reaching saturation levels with regard to ICT penetration. The most significant decreases in global IDI rank, however, occurred in the lower half of the regional ranking. Countries such as Poland (-7), Montenegro (-6), Greece, Portugal (both -4), Croatia, Cyprus and Czech Republic (all -3) lost ground to countries from the CIS, the Americas and the Arab States region that are moving up the IDI. Poland and the Czech Republic lost places on the use sub-index, in particular because wireless-broadband penetration grew very little, an indicator that is very dynamic in the developing world. On the other hand, some European countries are still moving up the IDI rankings. Most importantly, Denmark took the leading position in the IDI 2013, replacing long-time number one Republic of Korea. Bosnia and Herzegovina made the largest improvement in rank of all European countries, jumping from 74th to 69th position in the IDI 2013 (see Table 3.7).

Most European countries have achieved very high values on the access sub-index of the IDI. Luxembourg, Switzerland, Iceland (which form the top three on this sub-index) as well as Germany and the United Kingdom have a sub-index value of above nine. By end 2013, only one country (Andorra) had a mobile-cellular penetration of less than 90 per cent. Most remaining countries well exceeded 100 per cent penetration, and no significant increases took place from 2012 to 2013, which indicates that saturation has been reached in most European mobile-cellular markets. Data from the Eurobarometer underlines this finding: on average, 92 per cent of European Union citizens (the majority of countries in the region are members of the EU) had access to a mobile phone in 2013 (European Commission, 2014b).

The region benefits from an abundant supply of international Internet bandwidth. The highest levels are reached in international hubs such as Germany, Luxembourg and the United Kingdom. High amounts of bandwidth per Internet user, as registered in most European countries, ensure that a large number of Internet users can go online at high speeds.

Around three-quarters of European households have access to the Internet at home. The highest proportions of households connected to the

Internet are found in Iceland (96 per cent), Luxembourg (95 per cent), the Netherlands (95 per cent) and Norway (94 per cent). Those countries also display an equally high level of households with a computer. In the majority of countries in Europe (25 out of 40), 70 per cent of households have Internet access; and in an even higher number of countries (28 out of 40), 70 per cent of households have a computer. Albania ranks last in the region also in terms of household ICT penetration, with 22 per cent of households with a computer and 24.5 per cent with Internet access by end 2013. Among the countries that made the most progress in connecting households to the Internet from 2012 to 2013 are Italy (from 63 to 69 per cent), Czech Republic (from 65 to 73 per cent) and Estonia (from 75 to 80 per cent).

Very high household ICT penetration levels having been reached in most of the countries in

Table 3.7: IDI – Europe

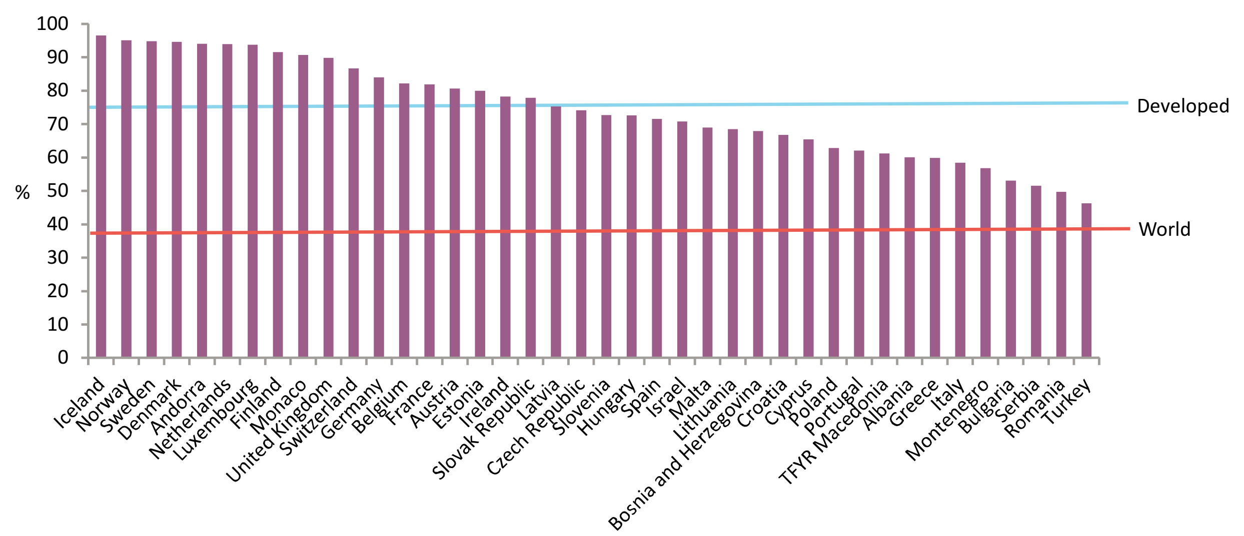
Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
Denmark	1	1	8.86	2	8.78	1
Sweden	2	3	8.67	3	8.68	0
Iceland	3	4	8.64	4	8.58	0
United Kingdom	4	5	8.50	7	8.28	2
Norway	5	6	8.39	6	8.35	0
Netherlands	6	7	8.38	5	8.36	-2
Finland	7	8	8.31	8	8.27	0
Luxembourg	8	10	8.26	9	8.19	-1
Switzerland	9	13	8.11	13	7.94	0
Monaco	10	15	7.93	17	7.72	2
Germany	11	17	7.90	18	7.72	1
France	12	18	7.87	16	7.73	-2
Andorra	13	20	7.73	24	7.41	4
Estonia	14	21	7.68	21	7.54	0
Austria	15	24	7.62	23	7.46	-1
Belgium	16	25	7.57	26	7.33	1
Ireland	17	26	7.57	22	7.48	-4
Spain	18	28	7.38	29	7.14	1
Israel	19	29	7.29	27	7.25	-2
Malta	20	30	7.25	30	7.08	0
Slovenia	21	31	7.13	31	6.96	0
Latvia	22	33	7.03	33	6.84	0
Italy	23	36	6.94	36	6.66	0
Croatia	24	37	6.90	34	6.70	-3
Greece	25	39	6.85	35	6.70	-4
Lithuania	26	40	6.74	40	6.50	0
Czech Republic	27	41	6.72	38	6.57	-3
Portugal	28	43	6.67	39	6.57	-4
Poland	29	44	6.60	37	6.63	-7
Slovakia	30	45	6.58	45	6.30	0
Hungary	31	46	6.52	44	6.35	-2
Bulgaria	32	49	6.31	47	6.12	-2
Serbia	33	50	6.24	49	6.07	-1
Cyprus	34	51	6.11	48	6.09	-3
Romania	35	58	5.83	58	5.52	0
TFYR Macedonia	36	60	5.77	62	5.42	2
Montenegro	37	63	5.67	57	5.52	-6
Turkey	38	68	5.29	68	5.12	0
Bosnia and Herzegovina	39	69	5.23	74	4.89	5
Albania	40	84	4.72	85	4.42	1
Average*			**7.14**		**6.98**	

Note: *Simple averages.
Source: ITU.

the region, the focus of policy-makers is shifting from providing access to ICTs to improving the quality and speed of access. A number of recent studies have pointed to the disparities in levels of broadband speeds that persist throughout the European Union (EU). The EU seeks to create a coherent broadband market within the Union, in terms of speeds, but also pricing and information/transparency that is required from operators.[23] The provision of fast and ultra-fast Internet access is one of the goals of the European Digital Agenda. Fast broadband coverage (defined at 30 Mbit/s) should be available throughout the entire EU and 50 per cent of households should have a broadband subscription with an advertised speed of at least 100 Mbit/s by 2020.[24]

High-quality and high-speed access are the foundations for making full use of ICTs. Europe stands out with very high levels of ICT usage throughout most countries in the region. Wireless-broadband services are available in every European country, and the large majority of countries have a penetration rate of more than 50 per cent. Finland (123.4 per cent), Sweden (110 per cent) and Denmark (107 per cent) have the highest penetration rates in the region, while Albania, Hungary, Bosnia and Herzegovina and Montenegro have the lowest, at less than 30 per cent. Growth in wireless-broadband penetration continued at double-digit rates from 2012 to 2013 in the majority of European countries. Some of the highest increases (from 2012 to 2013) took place in Bosnia and Herzegovina (from 12 per cent to 24 per cent), Albania (from 19 per cent to 28 per cent), Romania (from 27 per cent to 38 per cent), TFYR Macedonia (from 25 per cent to 40 per cent) and Slovakia (from 39 per cent to 55 per cent). In Albania, the incumbent operator launched its 3G services in early 2013, increasing competition in the market.[25] Operators in Slovakia and Romania have extended and upgraded their networks and started to offer LTE services to customers. The top five countries in the world in terms of fixed-broadband penetration (Monaco, Switzerland, Denmark, Netherlands and France) are all European. Average fixed-broadband penetration in the region stands at 27 per cent by end 2013, way above the global average of 9 per cent. With the exception of Albania, where fixed-broadband

Chart 3.11: Percentage of Individuals using the Internet, Europe compared to global and developed-country average, 2013



Note: Data on Individuals using the Internet for Eurostat members are sourced from Eurostat. Eurostat collects data for Internet users aged 16-74 years old.
Source: ITU World Telecommunication/ICT Indicators database.

penetration stands at 6 per cent, all European countries exceed the global average penetration.

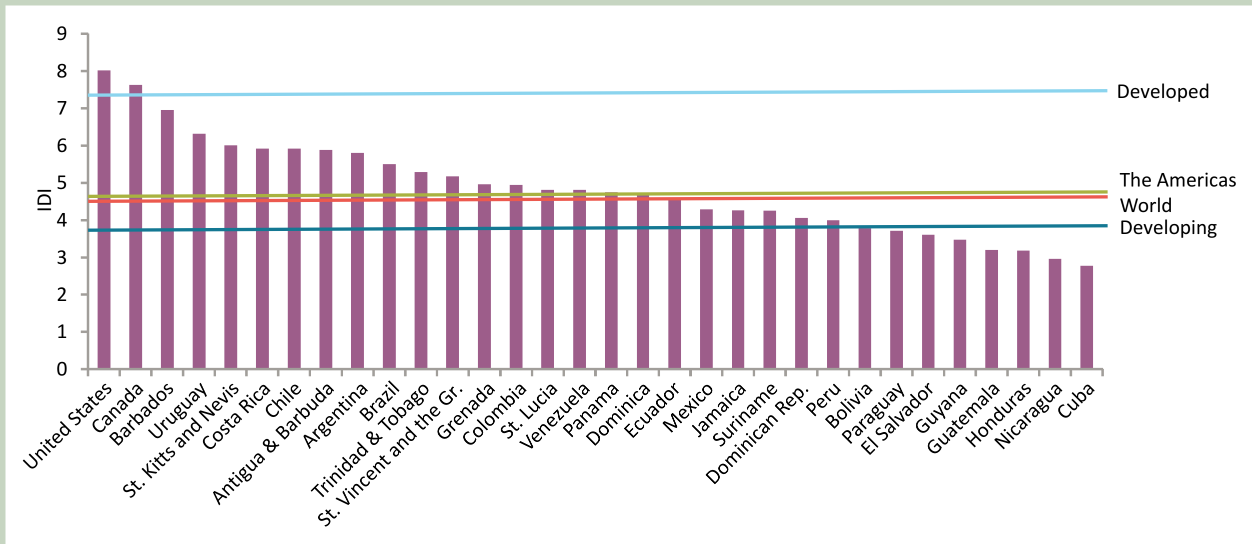
A well-developed ICT infrastructure and the availability of high-speed broadband Internet access and relevant content are reflected in a higher proportion of Internet users in the region. Close to half a billion Europeans were online in 2013, which corresponds to 73 per cent of the population. Iceland has the highest proportion of Internet users globally, at 96.5 per cent, followed by three other Nordic countries – Norway, Sweden and Denmark – with 95 per cent of the population using the Internet. Turkey has the lowest proportion of Internet users, at below 50 per cent. In Romania, too, less than half of the population are online (Chart 3.11).

3.6 The Americas

The United States and Canada lead the Americas regional ranking, with IDI values of 8.02 and 7.62, respectively. Half of the countries in the Americas have IDI values above the global average, while the other half fall below. Uruguay is the highest ranked Latin American country, with an IDI of 6.32, which is significantly above the regional (4.86) and developing-country (3.84) average. The region's most populous developing country, Brazil (5.50), also lies above the regional and developing-country averages. Cuba is the only LCC in the Americas, and has an IDI value of just 2.77. The lower-middle income countries Bolivia, El Salvador, Guatemala, Guyana, Honduras, Nicaragua and Paraguay also fall short of the developing-country average (see Chart 3.12).

Colombia, the Dominican Republic, Trinidad and Tobago and Uruguay were the most dynamic countries in the region. On the access sub-index, Bolivia and Mexico stand out for substantial improvements in ICT infrastructure development. However, from 2012 to 2013, more countries in the Americas declined than improved in the global IDI rankings. Those that dropped down the global rankings from 2012 to 2013 include Panama and Suriname (-5 ranks) and Peru (-4 ranks). In particular, Cuba is falling further behind, ranking 125th in the IDI 2013 as against 122nd in 2012 (see Table 3.8). The country's mobile-cellular

Chart 3.12: IDI values compared with the global, regional and developing/developed-country averages, the Americas, 2013



Source: ITU.

Table 3.8: IDI – The Americas

Economy	Regional rank 2013	Global rank 2013	IDI 2013	Global rank 2012	IDI 2012	Global rank change 2012-2013
United States	1	14	8.02	14	7.90	0
Canada	2	23	7.62	25	7.37	2
Barbados	3	35	6.95	32	6.87	-3
Uruguay	4	48	6.32	51	5.92	3
St. Kitts and Nevis	5	54	6.01	52	5.89	-2
Costa Rica	6	55	5.92	55	5.64	0
Chile	7	56	5.92	54	5.68	-2
Antigua & Barbuda	8	57	5.89	59	5.49	2
Argentina	9	59	5.80	56	5.58	-3
Brazil	10	65	5.50	67	5.16	2
Trinidad & Tobago	11	67	5.29	70	4.99	3
St. Vincent and the Grenadines	12	72	5.17	69	5.04	-3
Grenada	13	76	4.96	75	4.83	-1
Colombia	14	77	4.95	80	4.61	3
St. Lucia	15	79	4.81	79	4.66	0
Venezuela	16	80	4.81	78	4.68	-2
Panama	17	82	4.75	77	4.69	-5
Dominica	18	83	4.72	81	4.58	-2
Ecuador	19	88	4.56	88	4.28	0
Mexico	20	95	4.29	94	4.07	-1
Jamaica	21	97	4.26	98	4.01	1
Suriname	22	98	4.26	93	4.08	-5
Dominican Rep.	23	102	4.06	105	3.78	3
Peru	24	105	4.00	101	3.92	-4
Bolivia	25	107	3.78	109	3.52	2
Paraguay	26	109	3.71	108	3.56	-1
El Salvador	27	110	3.61	110	3.47	0
Guyana	28	111	3.48	111	3.44	0
Guatemala	29	118	3.20	117	3.11	-1
Honduras	30	119	3.18	119	3.01	0
Nicaragua	31	120	2.96	120	2.78	0
Cuba	32	125	2.77	122	2.69	-3
Average*			**4.86**		**4.67**	

Note: *Simple averages.
Source: ITU.

penetration is one of the lowest in the world and increased only marginally from 2012 to 2013. Broadband is almost non-existent, with wireless-broadband services still not available in 2013 and a fixed-broadband penetration of less than 1 per cent.

With an average mobile-cellular penetration of 107 per cent by end 2013, penetration is reaching saturation levels in the Americas. Few countries saw noteworthy increases in subscriptions from 2012 to 2013. While penetration exceeded 150 per cent in Panama, Argentina and Uruguay by end 2013, Cuba is seriously lagging behind, with only 18 per cent penetration. The country's *Empresa de Telecomunicaciones de Cuba* has one of the last state telecommunication-sector monopolies in the world.

International Internet connectivity, measured in bit/s per Internet user, is ample in the United States and Canada, and Brazil[26] also has a large amount of bandwidth. Brazil is connected within the region and across the Atlantic Ocean through a multitude of submarine cables. Colombia managed to quadruple its amount of international Internet bandwidth, from around 20 000 bit/s per Internet user in 2012 to close to 80 000 bit/s in 2013.

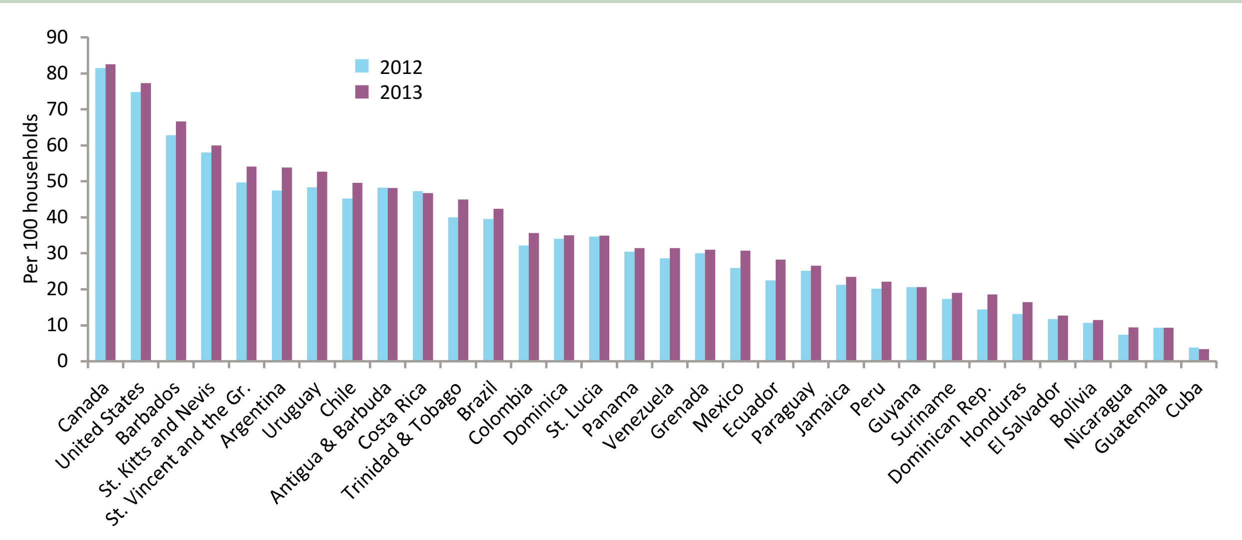
The Americas region has a relatively high household ICT penetration. By end 2013, on average, 55 per cent of households had Internet, which is the second highest regional average after Europe (76 per cent). This relatively strong regional average is driven by high penetration in the region's developed countries, namely Canada (83 per cent) and the United States (77 per cent). In addition, however, some of their Latin American neighbours boast a significant proportion of households connected to the Internet: in Argentina, 54 per cent of households have Internet access, as do 53 per cent of households in Uruguay and 50 per cent in Chile. In more than one-third of countries in the region, at least 40 per cent of households had Internet access and at least 50 per cent had a computer. Household Internet access remains very low in the LCC Cuba (3 per cent), as well as in Guatemala and Nicaragua, where around 9 per cent of households have Internet access.

Governments in the Americas have taken a proactive role by investing in ICT infrastructure, some of them through public-private partnerships (PPP), to extend and upgrade networks, in particular in rural areas, and by negotiating agreements with telecom operators to offer discounted price plans (Galperin, 2012).

Through national broadband plans, governments in the Americas are recognizing the potential of ICTs to support economic development. Connecting households with ICTs is central to brining more people online, and good progress is visible in numerous countries in the region: Ecuador saw one of the highest increases in the proportion of households with Internet access, up from 22 per cent in 2012 to 28 per cent in 2013, while Mexico and the Dominican Republic both improved by five percentage points to 31 per cent and 19 per cent of households with Internet by end 2013, respectively. Brazil and Colombia made good progress at a somewhat higher level of household penetration, reaching 42 per cent and 36 per cent of households with Internet by end 2013, respectively (see Chart 3.13).

Wireless-broadband networks are being extended through PPPs in many countries in the region in order to increase access to ICTs. Furthermore, a number of countries awarded LTE licences or further extended 3G coverage in 2013, spurring growth in the mobile sector. The United States has the highest wireless-broadband penetration, at 94 per cent by end

Chart 3.13: Proportion of households with Internet access, the Americas, 2012 and 2013



Source: ITU World Telecommunication/ICT Indicators database.

2013. It was an early adopter of LTE technology, and coverage was massively extended throughout the country in 2013. The operator Verizon had achieved 97 per cent LTE population coverage, and the majority of all data traffic is carried by the LTE network.[27] Very high increases were reported by Brazil, where 40 million new wireless-broadband subscriptions were added within a year, resulting in a penetration of 52 per cent by end 2013. LTE services were first launched in the country in early 2013.[28] Antigua and Barbuda (from 23 per cent to 49 per cent), Colombia (from 15 per cent to 25 per cent) and Saint Lucia (from 19 per cent to 33 per cent) also show very good progress in terms of wireless-broadband penetration from 2012 to 2013. While the majority of countries in the Americas region are making remarkable progress in extending their wireless-broadband networks, services were still not available in Cuba, Dominica, Guyana and St. Vincent and the Grenadines by end 2013.

Fixed-broadband penetration is high in regional but also global comparison in the United States (33 per cent) and Canada (28 per cent). St. Kitts and Nevis, Barbados and Uruguay also display relatively high levels of more than 20 per cent penetration by end 2013. Uruguay registered the highest absolute increase from 2012 to 2013, with penetration rates rising from 16.5 per cent to 21 per cent. The country has some of the lowest fixed-broadband prices in the region, which has contributed to driving uptake (Chapter 3). A number of countries in the Americas, particularly those that were late adopters of mobile-broadband technology such as Dominica, Grenada and St. Vincent and the Grenadines, have significantly higher fixed-broadband than wireless-broadband penetration rates.

Close to 1 billion people are using the Internet in the Americas region. While the highest proportion of individuals using the Internet is to be found in the United States and Canada, more than half of the population is online in countries such as Argentina, Brazil, Chile, Colombia, Uruguay and Venezuela.

Endnotes

1 See: http://www.itu.int/ITU-D/ict/definitions/regions/index.html.

2 The standard deviation (StDev) shows the average distance of a value to the mean. The coefficient of variation (CV) measures the dispersion of a variable independently of the variable's measurement unit. The higher the CV, the greater the dispersion in the variable.

3 http://www.cvmovel.cv/nacional-gsm-3g-edge-e-gprs.

4 http://www.telegeography.com/products/commsupdate/articles/2014/04/24/mtn-reports-210-1m-subscribers-at-end-march/?utm_source=CommsUpdate&utm_campaign=76faf56793-CommsUpdate+24+April+2014&utm_medium=email&utm_term=0_0688983330-76faf56793-8868625 and http://www.telegeography.com/products/commsupdate/articles/2012/10/22/airtel-widens-3-5g-footprint/.

5 http://www.gsmamobileeconomyafrica.com/Sub-Saharan%20Africa_ME_Report_English_2013.pdf.

6 http://www.epegcable.com/.

7 http://www.gbiinc.com/SitePages/News_Details.aspx?itmID=110.

8 http://www.omantel.om/OmanWebLib/Individual/Internet/pc_initiative.aspx?linkId=3&MenuId=420 and http://www.ita.gov.om/ITAPortal/Pages/Page.aspx?NID=617&PID=2209&LID=111.

9 http://www.qatar-tribune.com/viewnews.aspx?n=4392EF47-A715-496F-BF1D-A0EE8B74D0E7&d=20140128.

10 http://www.telecompaper.com/news/algeria-awards-3g-licences-to-all-three-bidders--972965.

11 Internet user data from Gulf countries are not comparable, as they refer to different populations. Data from Bahrain and Qatar refer to the overall population, i.e. including expatriate/transient workers. Data from United Arab Emirates are estimated by ITU based on base data excluding the transient worker population.

12 Reported in activated external capacity.

13 http://www.ofca.gov.hk/en/industry_focus/telecommunications/facility_based/infrastructures/submarine_cables/index.html.

14 http://submarinenetworks.com/systems/intra-asia/sjc/sjc-cable-system.

15 http://www.submarinecablemap.com/#/submarine-cable/boracay-palawan-submarine-cable-system.

16 http://web.nso.go.th/en/survey/data_survey/560619_2012_Information-.pdf.

17 http://www.digitimes.com/news/a20131227PD215.html and http://www.eurobiz.com.cn/chinas-broadband-strategy/.

18 http://file.eu-chinapdsf.org/Internet/PUB/Activity4/Results%203/Broadband%20China%20introduction_Yu%20Xiaohui.pdf.

19 Belarus, Moldova, Russian Federation and Ukraine are considered as developed countries according to the UN classification.

20 See ITU Interactive Transmission Map: http://www.itu.int/en/ITU-D/Technology/Pages/InteractiveTransmissionMaps.aspx.

21 http://www.mtsgsm.com/upload/contents/328/2008_07_25_3G_Strategy.pdf.

22 http://www.mtsgsm.com/news/2014-01-23-61993/ and http://english.corp.megafon.ru/news/20140425-1712.html.

23 http://europa.eu/rapid/press-release_IP-14-314_en.htm.

24 http://ec.europa.eu/digital-agenda/en/digital-agenda-scoreboard.

25 http://www.telegeography.com/products/commsupdate/articles/2013/03/01/the-eagle-has-landed-incumbent-swoops-into-3g-sector/.

26 Data reported by the country refer to 2012.

27 http://www.verizonwireless.com/wcms/consumer/4g-lte.html and http://www.telecompaper.com/news/verizon-wireless-lte-reaches-500-markets--952458.

28 http://www.rcrwireless.com/article/20121214/carriers/claro-first-launch-lte-services-brazil/.

Chapter 4. ICT prices and the role of competition

4.1 Introduction

The price of ICT services constitutes a determining factor for ICT uptake and, as such, continues to be a focus of attention for regulators and policy-makers. Affordability remains the main barrier to Internet access at home in many developing countries. In Brazil, for instance, 44 per cent of all households with a computer did not have Internet in 2013 because they considered it too expensive or beyond their means (CETIC.BR, 2013). In developed countries, although not having Internet at home may be more attributable to other factors, such as lack of interest, cost still represents a barrier for many people. In the European Union, around one in five households without Internet cite cost as the reason, and seven out of ten of those who have Internet state that price is the most important factor when choosing the service (European Commission, 2013; European Commission, 2014). The importance of affordability also applies to other ICT services, and its impact goes beyond access, also influencing usage: over half of EU citizens limit their national mobile phone calls because of concerns about cost (European Commission, 2014).

In response to the demand for global benchmarks on ICT prices, ITU has been collecting ICT price data following a harmonized methodology since 2008. Initially, prices were collected for fixed-telephone, mobile-cellular (voice and SMS) and fixed-broadband services. Since 2012, the data collection has been extended to include mobile-broadband prices. These data have proved to be useful for the international comparison of ICT prices across more than 160 countries, and for identifying those cases where prices constitute a barrier to ICT uptake.

This year's analysis of ICT prices goes beyond simply measuring affordability, and provides some insights into the relationship between affordability and income inequality, competition and regulation. The objective is to single out some salient explanatory factors for the affordability of ICT prices, and offer a quantitative assessment of how policy actions targeting these factors may help in making ICT services more affordable and thus increase ICT access and use.

The affordability of an ICT service does not only depend on its price, but also on the means of each specific income group within a country to whom the service is offered, and on the distribution of income within a community. There is growing interest in considering income inequality in the international development debate.[1] The work on income distribution stems partly from the tracking of global objectives on poverty reduction, such as the Millennium Development Goals (MDGs), but also from the growing academic attention given to this topic in the aftermath of the global financial crisis. In the context of ICTs, income distribution also plays a role in determining uptake, because it conditions affordability.

The effects of competition in driving prices down and fostering innovation have been most apparent in the mobile-cellular market, where low prepaid prices became a key enabler for the mass uptake of mobile-cellular services observed in the developing world in the last decade; but they also apply to other telecommunication markets. Regulation sets the framework for competition, and is thus the lever which policy-makers and regulators can use to influence competition. As a result, of all the important elements in the analysis of the affordability of ICT prices, competition and regulation are those upon which telecommunication administrations may exert more direct control. They therefore merit particular attention.

This chapter will present and discuss key metrics for monitoring the global affordability of ICT services. It will first look at prices in the voice market and their evolution in the period 2008-2013. This will be followed by a more in-depth analysis of prices in the broadband market in the same period, highlighting some pricing trends in the most dynamic market segment: mobile broadband. Then, the affordability of ICT services will be analysed in the light of household income inequalities, thereby quantifying how far low-income segments of the population may be excluded from the information society by price barriers. The final part of the chapter will assess the impact of competition and regulation on ICT prices. Based on an econometric model, a number of conclusions will be presented on the effects of competition and regulation on mobile-cellular and fixed-broadband prices.

The results of the latest ICT Price Basket (IPB) are presented in Table 4.15 at the end of this chapter. They include end-2013 data for each of the three price sets contained in the IPB (fixed-telephone, mobile-cellular and fixed-broadband services), as well as the general IPB ranking combining the three sub-baskets expressed in terms of GNI per capita (GNI p.c.).

Prices in this chapter are expressed in three complementary units:

- In USD, using the IMF annual rates of exchange.
- In international dollars (PPP$), using purchasing power parity (PPP) conversion factors instead of market exchange rates. The use of PPP exchange factors helps to screen out price and exchange-rate distortions, thus providing a measure of the cost of a given service taking into account the purchasing power equivalences between countries.[2]
- As a percentage of countries' monthly GNI p.c. (Atlas method).[3] Prices are expressed as a percentage of GNI p.c. in order to show them in relative terms to the size of the economy of each country, thus pointing to the affordability of each ICT service at a country level.

The methodological details of the IPB and the collection of mobile-broadband prices can be found in Annex 2.

4.2 Fixed-telephone and mobile-cellular prices

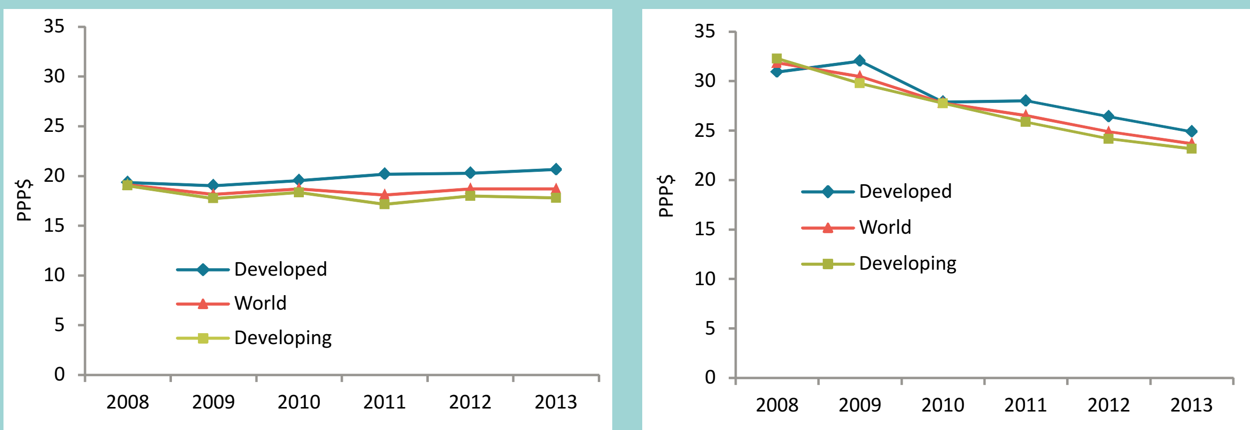
Traditional voice services[4] and SMS have become the most ubiquitous ICT services,overtaking historical ICTs such as radio and television broadcasting in many countries. For instance, only 9 per cent of households had a telephone in India in 2001, compared with 32 per cent of households with a TV and 35 per cent of households with a radio. By 2011, however, the percentages were reversed: 63 per cent of households had a telephone, 47 per cent a TV and 20 per cent a radio.[5]

Despite the decline in fixed-telephone subscriptions over the last decade, fixed telephony remains the most widespread ICT service based on fixed (wired) telecommunication networks. Global fixed-telephone penetration stood at 16 per cent by end 2013, compared with 9 per cent fixed (wired)-broadband penetration. The coverage gaps in the fixed-telephone network have been filled by the mobile-cellular network, which covers 93 per cent of the global population. This compares with a global 3G coverage of around 50 per cent by end 2012, highlighting that mobile-broadband services are likewise less available than mobile voice and SMS (see Chapter 1). Subscription figures confirm this: despite double-digit mobile-broadband growth rates, there are three times as many mobile-cellular voice subscriptions as mobile-broadband subscriptions, with almost as many mobile-cellular subscriptions as people on earth.

Traffic figures show that, in almost all countries, the bulk of national voice traffic corresponds to calls made from mobile networks, thus confirming the shift from fixed to mobile voice. International voice traffic is also predominantly mobile in most countries, although the number of international fixed-telephone minutes still exceeds international mobile voice minutes in one in four countries. This situation occurs more frequently in the developed world: there is more fixed than mobile international telephone traffic in 36 per cent of the developed countries, as against only 18 per cent of the developing countries. These differences are consistent with the higher fixed-telephone penetration rates recorded in developed countries – almost four times higher than in developing countries; differences in mobile-cellular penetration are smaller. These findings highlight that fixed telephony is still used more than mobile telephony in some countries for making international calls.

Such a ubiquitous uptake of voice services would not have been possible without affordable prices. Chart 4.1 shows the evolution of fixed-telephone and mobile-cellular prices in the period 2008-2013. A basic fixed-telephone service costs on average PPP$ 18.7 (or USD 13.9) per month by end 2013; a prepaid low-user mobile-cellular subscription costs on average PPP$ 23.7 (or USD

Chart 4.1: Fixed-telephone basket (left) and mobile-cellular basket (right), in PPP$, world and by level of development, 2008-2013



Note: Simple averages. Based on 140 economies for which 2008-2013 data on fixed-telephone and mobile-cellular prices were available.
Source: ITU.

16.2) per month.[6] This compares with an average of PPP$ 53.0 (or USD 31.9) per month for an entry-level fixed-broadband plan, and PPP$ 28.4 (or USD 19.5) per month for a prepaid mobile-broadband service with a 500 MB monthly data allowance.[7] Despite the limitations of comparing such different services, the results roughly confirm that fixed-telephone and mobile-cellular prices are the cheapest among ICT services, suggesting that low prices have contributed to the widespread adoption of traditional voice and SMS services.

Fixed-telephone prices have followed an almost flat evolution, with a small decrease in prices observed during the period in developing countries (-1.3 per cent compound annual growth rate (CAGR) in the developing world in the period 2008-2013). The fixed-telephone market is the most mature segment of those included in the ITU price data collection exercise. Growth rates have been stagnating since 2008, and there have been few structural changes in the market: 78 per cent of the countries with price data had already fully or partially liberalized their fixed-telephone market in 2008, compared with 88 per cent in 2013. Moreover, in some cases liberalization has signalled the end of cross-subsidies for fixed-telephone services, and the deregulation of retail fixed-telephone prices. The cheapest fixed-telephone prices are found in countries where there is still strong government control over the main fixed-telephone operator, such as the Islamic Republic of Iran, Cuba and Moldova, where basic fixed-telephone services cost less than USD 0.5 per month (Table 4.1).

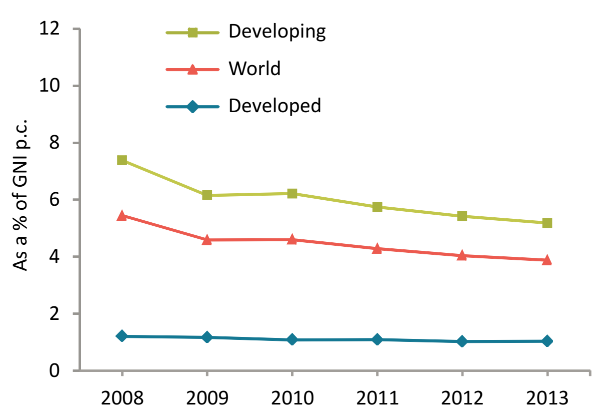
Mobile-cellular prices have declined in the period 2008-2013, with a CAGR of -5.7 per cent globally. The decrease in prices has affected developed and developing countries alike, with -4.3 and -6.4 per cent CAGR, respectively. Mobile-cellular penetration was already above 100 per cent in developed countries in 2008, but pro-competitive measures – such as mobile number portability, reductions in mobile termination rates and the licensing of new entrants, including mobile virtual network operators (MVNOs) – have been implemented and thus driven prices down. In developing countries, the number of mobile-cellular subscriptions almost doubled in the period 2008-2013. Operators developed innovative prepaid offers at reduced prices to reach the huge customer base that remained untapped in 2008, thus growing organically and benefitting from economies of scale.

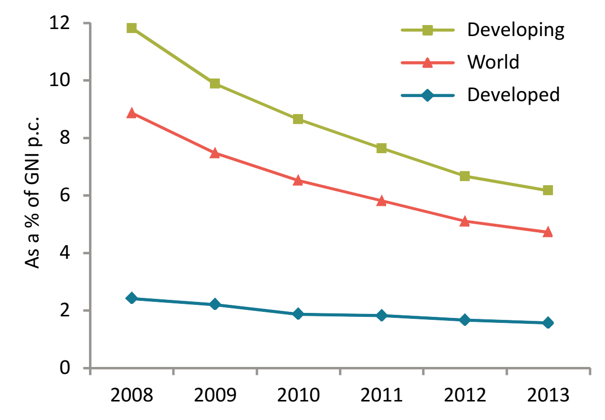
The top countries with the cheapest prepaid mobile-cellular plans are all from the developing world, including 15 countries where a low-usage monthly mobile-cellular plan costs less than USD 5 per month (Table 4.2). Most countries with the cheapest prepaid mobile-cellular prices are in the Asia and the Pacific region, with Sri Lanka (USD 0.95 or PPP$ 2.6 per month) and Bangladesh (USD 1.41 or PPP$ 4.0 per month) standing out with the lowest prepaid mobile-cellular prices in the world. These are examples of the levels of efficiency that operators can achieve, and how cheaper prices may help reach low-income users (who can afford the service) and extend operators' customer bases, even if at lower margins for some segments.[8]

Prices in PPP$ or USD show the supply-side perspective, i.e. the price that the operator sets for the service. To better understand how much the price of a given ICT service represents for the user in each country, prices are also presented as a percentage of GNI p.c., so as to provide an insight into the affordability of fixed-telephone and mobile-cellular services from a demand-side perspective (Chart 4.2).

From this perspective, voice services are less affordable in developing countries than in developed countries. By end 2013, a basic fixed-telephone service cost on average 1.0 per cent of GNI per capita in developed countries compared with 5.2 per cent in developing countries. There are, however, notable exceptions, with developing countries such as Islamic Republic of Iran, Cuba, Venezuela and Qatar topping the ranking of the world's most affordable fixed-telephone services with prices below 0.2 per cent of GNI p.c. The relatively high

Chart 4.2: Fixed-telephone basket (left) and mobile-cellular basket (right), as a percentage of GNI p.c., world and by level of development, 2008-2013





Note: Simple averages. Based on 140 economies for which 2008-2013 data on fixed-telephone and mobile-cellular prices were available.
Source: ITU.

average in developing countries is explained by the large dispersion of fixed-telephone prices in the developing world: affordability ranges from less than 0.2 per cent of GNI p.c. in the countries cited above, to more than 30 per cent of GNI p.c. in Niger, Central African Republic, Malawi and Madagascar (Table 4.1). If the affordability target set by the Broadband Commission for Digital Development for broadband prices (less than 5 per cent of monthly GNI p.c. by 2015) were applied to fixed-telephone prices, there would be 35 developing countries not meeting the target in 2013, most of them from Africa. On the other hand, all developed countries would already have met the target in 2008. A fixed-line fee is in most cases required for contracting ADSL services. Since ADSL is currently the predominant fixed-broadband technology,[9] it is thus relevant to track the cost of fixed-line subscriptions also in the context of fixed-broadband prices.

By end 2013, a low-usage prepaid mobile-cellular service cost on average 1.6 per cent of GNI p.c. in developed countries, as against 6.2 per cent in developing countries. Although affordability improved in developing countries, from an average of 11.8 per cent of GNI p.c. in 2008 to 6.2 per cent in 2013, in 43 developing countries mobile-cellular services still cost more than 5 per cent of GNI p.c. in 2013. The affordability of basic mobile-cellular services remains a major barrier to further adoption in several African countries: of the 20 countries with the least affordable mobile-cellular prices in 2013, 16 were from Africa. These countries could follow the best practices of other economies in the region, such as Kenya and Ghana, which have succeeded in bringing prices down through a pro-competitive approach (see Box 3.1 in ITU, 2011).

The case of Kenya points to the importance, but also the limits, of operators' actions as a stimulus to make mobile-cellular prices affordable. Despite Kenya being one of the most dynamic mobile markets in Africa and having the twelfth cheapest prices in USD in the world (USD 3.8 for a low-user basket in 2013), they still represented 5.0 per cent of GNI p.c., on account of the country's low-income level.[10] Further reductions in mobile-cellular prices could be achieved by combining regulatory actions to promote competition – such as fostering inter-operator competition continuing with the glide-path set for mobile termination rates (MTRs) (CCK, 2010), allowing the entry of MVNOs[11] and streamlining mobile number portability[12] – and policy initiatives to strengthen the demand side.

Table 4.1: Fixed-telephone sub-basket, 2013

		Fixed-telephone sub-basket			GNI p.c.,
Rank	Economy	as % of GNI p.c.	USD	PPP$	USD, 2013*
1	Iran (I.R.)	0.03	0.12	0.26	5'780
2	Cuba	0.05	0.24	-	6'014
3	Venezuela	0.11	1.18	1.49	12'550
4	Qatar	0.13	9.07	12.32	85'550
5	Macao, China	0.16	8.39	11.35	64'691
6	Belarus	0.17	0.97	2.58	6'720
7	Singapore	0.20	8.80	9.10	54'040
8	Moldova	0.23	0.48	1.04	2'460
9	Trinidad & Tobago	0.24	3.22	4.04	15'760
10	Kuwait	0.27	10.23	15.77	45'889
11	Korea (Rep.)	0.29	6.22	7.44	25'920
12	Bahrain	0.29	4.76	8.12	19'756
13	Norway	0.33	27.88	16.71	102'610
14	United Arab Emirates	0.33	10.62	-	39'006
15	Russian Federation	0.34	3.93	6.85	13'860
16	Suriname	0.37	2.87	4.86	9'260
17	Azerbaijan	0.42	2.55	5.90	7'350
18	Hong Kong, China	0.44	14.18	18.23	38'420
19	Luxembourg	0.45	27.20	20.51	72'528
20	Brunei Darussalam	0.46	12.55	18.91	33'002
21	United States	0.47	21.22	21.22	53'670
22	Oman	0.48	10.18	19.44	25'503
23	Switzerland	0.49	33.17	19.77	81'760
24	Kazakhstan	0.50	4.76	8.07	11'380
25	Australia	0.56	30.84	20.75	65'520
26	Sweden	0.57	28.20	20.19	59'130
27	Denmark	0.57	29.20	19.43	61'110
28	Costa Rica	0.60	4.80	6.57	9'550
29	Uzbekistan	0.62	0.97	-	1'900
30	Japan	0.62	23.72	20.63	46'140
31	Iceland	0.63	23.15	19.16	43'930
32	Israel	0.64	18.19	15.10	34'120
33	Austria	0.66	26.53	23.06	48'590
34	Mauritius	0.66	5.09	8.24	9'300
35	Bhutan	0.66	1.35	4.06	2'460
36	Canada	0.67	29.08	23.17	52'200
37	Germany	0.71	27.42	25.10	46'100
38	Maldives	0.73	3.42	4.44	5'600
39	Malta	0.78	12.97	15.15	19'927
40	France	0.79	27.94	23.80	42'250
41	Georgia	0.81	2.40	4.99	3'570
42	Estonia	0.83	12.06	14.03	17'370
43	Netherlands	0.83	32.94	27.79	47'440
44	Armenia	0.85	2.69	5.71	3'790
45	China	0.88	4.80	7.92	6'560
46	Finland	0.88	34.54	25.99	47'110
47	Seychelles	0.88	9.22	13.05	12'530
48	Uruguay	0.89	11.32	12.45	15'180
49	Morocco	0.90	2.26	4.55	3'030
50	Latvia	0.93	11.04	14.43	14'201
51	Bahamas	0.94	16.25	14.29	20'806
52	Slovenia	0.96	18.37	20.49	23'058
53	Belgium	0.97	36.50	31.02	45'210
54	Egypt	0.97	2.56	8.63	3'160
55	Guyana	0.98	3.05	-	3'750
56	Lithuania	0.99	11.50	16.54	13'958
57	United Kingdom	1.01	32.77	26.82	39'110
58	Panama	1.02	9.10	15.48	10'700
59	Malaysia	1.05	9.08	17.99	10'400
60	Cyprus	1.08	24.08	25.97	26'654
61	Italy	1.09	31.32	28.19	34'400
62	Sri Lanka	1.11	2.94	8.10	3'170
63	St. Kitts and Nevis	1.12	12.61	15.55	13'460
64	Antigua & Barbuda	1.19	12.78	15.55	12'910
65	Saudi Arabia	1.21	26.40	53.93	26'200
66	Ireland	1.23	40.36	31.76	39'501
67	Slovakia	1.25	18.09	23.79	17'372
68	New Zealand	1.26	37.72	29.30	35'875
69	Viet Nam	1.26	1.82	4.44	1'730
70	Serbia	1.27	6.06	10.51	5'730
71	Croatia	1.29	14.30	19.40	13'330
72	Greece	1.29	24.23	25.16	22'530
73	Kyrgyzstan	1.30	1.30	3.40	1'200
74	Spain	1.31	31.97	31.33	29'180
75	Turkey	1.32	12.03	17.38	10'950
76	Ukraine	1.33	4.38	10.92	3'960
77	Algeria	1.33	5.87	13.51	5'290
78	Montenegro	1.33	8.06	13.33	7'260
79	Indonesia	1.34	4.00	9.54	3'580
80	Lebanon	1.37	11.28	-	9'870
81	Portugal	1.37	23.66	25.56	20'670
82	Thailand	1.38	6.18	14.55	5'370
83	Tunisia	1.44	5.23	11.29	4'360
84	Ecuador	1.51	6.94	12.16	5'510
85	Romania	1.57	11.88	16.27	9'060
86	Equatorial Guinea	1.60	19.13	-	14'320
87	Poland	1.73	18.70	30.74	12'960
88	Barbados	1.73	22.00	17.74	15'231
89	Mongolia	1.74	5.48	11.67	3'770
90	Czech Republic	1.76	26.49	34.89	18'060
91	Albania	1.82	7.11	13.03	4'700
92	Bulgaria	1.94	11.38	21.86	7'030
93	India	1.95	2.55	8.52	1'570
94	Bosnia and Herzegovina	1.97	7.79	13.57	4'740
95	Namibia	1.98	9.63	16.69	5'840
96	St. Vincent and the Grenadines	1.98	10.86	14.39	6'580
97	Swaziland	2.01	5.15	11.05	3'080
98	Guatemala	2.05	5.70	11.06	3'340
99	Dominica	2.14	12.06	16.13	6'760
100	Grenada	2.16	13.41	17.51	7'460
101	Hungary	2.17	22.71	35.36	12'534
102	TFYR Macedonia	2.18	8.71	17.35	4'800
103	Botswana	2.20	14.20	-	7'730
104	Ethiopia	2.22	0.87	2.31	470
105	St. Lucia	2.27	13.41	16.59	7'090
106	Mexico	2.27	18.80	25.61	9'940
107	Jordan	2.28	9.42	19.64	4'950
108	Peru	2.36	12.58	21.06	6'390
109	Chile	2.38	30.27	37.90	15'230
110	Brazil	2.50	24.34	29.26	11'690
111	Paraguay	2.55	8.57	15.54	4'040
112	Colombia	2.67	16.80	25.81	7'560
113	Fiji	2.68	9.88	14.56	4'430
114	Jamaica	2.73	11.85	16.62	5'220
115	Ghana	2.76	4.05	8.52	1'760
116	Afghanistan	2.78	1.62	4.56	700
117	Nigeria	3.18	7.30	12.13	2'760
118	Dominican Rep.	3.24	15.16	29.10	5'620
119	South Africa	3.25	19.49	34.51	7'190
120	Honduras	3.48	6.33	11.98	2'180
121	El Salvador	3.49	10.82	20.60	3'720
122	Bangladesh	3.49	2.62	7.47	900
123	Cape Verde	3.61	10.92	18.97	3'630
124	Sudan	3.94	3.71	-	1'130
125	Angola	3.94	16.46	18.57	5'010
126	Lao P.D.R.	3.94	4.80	12.01	1'460
127	Pakistan	4.27	4.91	17.22	1'380
128	Samoa	4.31	12.33	15.13	3'430
129	Nepal	4.37	2.66	8.37	730
130	Nicaragua	4.59	6.81	15.79	1'780
131	Cambodia	4.80	3.80	9.81	950
132	Zambia	5.36	6.61	12.93	1'480
133	Belize	5.38	20.88	35.91	4'660
134	Kiribati	5.53	12.07	-	2'620
135	Gabon	5.69	50.52	69.76	10'650
136	Burundi	5.85	1.37	3.54	280
137	Philippines	6.05	16.49	36.15	3'270
138	Timor-Leste	6.61	19.72	31.49	3'580
139	S. Tomé & Principe	6.74	8.25	13.08	1'470
140	Haiti	7.68	5.18	10.00	810
141	Papua New Guinea	7.85	13.14	-	2'010
142	Lesotho	8.14	10.52	24.45	1'550
143	Solomon Islands	8.24	11.05	10.37	1'610
144	Rwanda	8.98	4.64	11.29	620
145	Eritrea	11.17	4.56	-	490
146	Bolivia	11.32	24.05	53.57	2'550
147	Marshall Islands	13.07	45.75	-	4'200
148	Senegal	13.39	11.94	24.31	1'070
149	Mali	14.22	7.94	17.47	670
150	Zimbabwe	14.89	10.18	-	820
151	Vanuatu	15.99	41.71	33.26	3'130
152	Kenya	16.78	13.00	28.31	930
153	Côte d'Ivoire	17.21	19.80	41.36	1'380
154	Mauritania	18.71	16.53	-	1'060
155	Togo	18.98	8.38	17.68	530
156	Cameroon	19.13	20.24	42.84	1'270
157	Tanzania	19.27	10.12	22.89	630
158	Benin	19.37	12.75	26.91	790
159	Uganda	21.09	8.96	21.11	510
160	Burkina Faso	25.38	14.17	31.25	670
161	Mozambique	26.62	13.09	24.70	590
162	Micronesia	27.81	79.50	-	3'430
163	Niger	43.45	14.84	32.31	410
164	Central African Rep.	48.20	12.85	22.87	320
165	Malawi	54.19	12.19	38.63	270
166	Madagascar	56.62	20.76	59.81	440
	Argentina**	-	3.40	-	-

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

Table 4.2: Mobile-cellular sub-basket, 2013

Rank	Economy	Mobile-cellular sub-basket as % of GNI p.c.	Mobile-cellular sub-basket USD	Mobile-cellular sub-basket PPP$	GNI p.c., USD, 2013*
1	Macao, China	0.11	5.68	7.68	64'691
2	Hong Kong, China	0.18	5.70	7.32	38'420
3	Denmark	0.19	9.87	6.57	61'110
4	Singapore	0.19	8.74	9.04	54'040
5	Qatar	0.26	18.68	25.38	85'550
6	United Arab Emirates	0.28	9.06	-	39'006
7	Switzerland	0.29	19.42	11.57	81'760
8	Norway	0.29	24.86	14.90	102'610
9	Austria	0.34	13.62	11.84	48'590
10	Australia	0.35	18.95	12.75	65'520
11	Finland	0.36	14.02	10.55	47'110
12	Sri Lanka	0.36	0.95	2.61	3'170
13	Cyprus	0.36	8.06	8.69	26'654
14	Kuwait	0.39	15.07	23.24	45'889
15	Sweden	0.42	20.54	14.70	59'130
16	Oman	0.43	9.11	17.41	25,503
17	Luxembourg	0.44	26.85	20.25	72'528
18	Iran (I.R.)	0.46	2.23	4.79	5'780
19	Germany	0.47	18.03	16.50	46'100
20	Costa Rica	0.51	4.06	5.56	9'550
21	New Zealand	0.52	15.58	12.10	35'875
22	Iceland	0.60	22.09	18.28	43'930
23	Russian Federation	0.64	7.34	12.79	13'860
24	Saudi Arabia	0.65	14.13	28.86	26'200
25	Brunei Darussalam	0.71	19.65	29.60	33'002
26	Bahrain	0.73	12.04	20.52	19'756
27	Canada	0.73	31.97	25.46	52'200
28	China	0.74	4.04	6.65	6'560
29	Lithuania	0.75	8.77	12.61	13'958
30	Mauritius	0.79	6.09	9.85	9'300
31	United States	0.80	35.62	35.62	53'670
32	Malaysia	0.83	7.16	14.20	10'400
33	Korea (Rep.)	0.86	18.58	22.23	25'920
34	Belgium	0.91	34.17	29.04	45'210
35	Japan	0.92	35.50	30.87	46'140
36	Portugal	0.93	16.03	17.31	20'670
37	Poland	1.01	10.86	17.85	12'960
38	Latvia	1.01	11.90	15.56	14'201
39	Bahamas	1.01	17.48	15.37	20'806
40	Venezuela	1.01	10.60	13.37	12'550
41	Netherlands	1.05	41.51	35.01	47'440
42	Slovakia	1.11	16.07	21.14	17'372
43	Trinidad & Tobago	1.14	15.02	18.85	15'760
44	France	1.14	40.29	34.33	42'250
45	Kazakhstan	1.15	10.91	18.48	11'380
46	Malta	1.20	19.85	23.19	19'927
47	Thailand	1.20	5.36	12.61	5'370
48	Italy	1.23	35.19	31.67	34'400
49	Maldives	1.23	5.74	7.45	5'600
50	Israel	1.24	35.32	29.32	34'120
51	Belarus	1.25	7.02	18.70	6'720
52	Slovenia	1.25	24.11	26.89	23'058
53	United Kingdom	1.31	42.62	34.89	39'110
54	Ireland	1.33	43.94	34.58	39'501
55	Bhutan	1.37	2.81	8.47	2'460
56	Mexico	1.40	11.58	15.77	9'940
57	Panama	1.41	12.59	21.42	10'700
58	Croatia	1.49	16.53	22.42	13'330
59	Seychelles	1.50	15.71	22.23	12'530
60	Mongolia	1.51	4.74	10.10	3'770
61	Spain	1.56	37.82	37.06	29'180
62	Estonia	1.59	23.09	26.86	17'370
63	Tunisia	1.62	5.90	12.72	4'360
64	Botswana	1.64	10.57	-	7'730
65	Czech Republic	1.66	25.04	32.99	18'060
66	Uruguay	1.67	21.10	23.22	15'180
67	Barbados	1.71	21.70	17.50	15'231
68	Azerbaijan	1.71	10.49	24.28	7'350
69	Antigua & Barbuda	1.78	19.12	23.26	12'910
70	Uzbekistan	1.82	2.89	-	1'900
71	Suriname	1.86	14.39	24.38	9,260
72	Bangladesh	1.88	1.41	4.03	900
73	Jordan	1.90	7.84	16.34	4'950
74	Montenegro	1.92	11.62	19.22	7'260
75	Chile	1.98	25.17	31.52	15'230
76	St. Kitts and Nevis	2.04	22.87	28.19	13'460
77	Georgia	2.05	6.10	12.67	3'570
78	Egypt	2.05	5.40	18.18	3'160
79	Jamaica	2.08	9.06	12.70	5'220
80	Namibia	2.13	10.36	17.94	5'840
81	Ukraine	2.18	7.19	17.91	3'960
82	Greece	2.18	40.97	42.55	22'530
83	India	2.23	2.91	9.74	1'570
84	Gabon	2.25	19.95	27.54	10'650
85	Indonesia	2.30	6.86	16.38	3'580
86	Hungary	2.40	25.07	39.03	12'534
87	Peru	2.43	12.93	21.64	6'390
88	Equatorial Guinea	2.46	29.31	-	14'320
89	Romania	2.49	18.80	30.46	9'060
90	Viet Nam	2.50	3.61	8.81	1'730
91	Armenia	2.60	8.22	17.49	3'790
92	TFYR Macedonia	2.83	11.31	22.53	4'800
93	Nigeria	2.83	6.51	10.81	2'760
94	Turkey	2.91	26.52	38.31	10'950
95	Dominican Rep.	2.91	13.62	26.16	5'620
96	Algeria	2.94	12.97	29.85	5'290
97	Dominica	2.97	16.74	22.40	6'760
98	Lebanon	3.00	24.71	-	9'870
99	Pakistan	3.17	3.65	12.79	1'380
100	Serbia	3.17	15.16	26.29	5'730
101	Guyana	3.20	10.01	-	3'750
102	Colombia	3.35	21.11	32.43	7'560
103	South Africa	3.40	20.40	36.12	7'190
104	Ghana	3.51	5.15	10.82	1'760
105	Grenada	3.54	21.98	28.70	7'460
106	Paraguay	3.64	12.24	22.19	4'040
107	Bosnia and Herzegovina	3.72	14.68	25.59	4'740
108	Philippines	3.72	10.15	22.24	3'270
109	Ecuador	3.74	17.17	30.10	5'510
110	Sudan	3.92	3.69	-	1'130
111	St. Vincent and the Grenadines	4.07	22.33	29.61	6'580
112	St. Lucia	4.21	24.89	30.78	7'090
113	Cuba	4.30	21.53	-	6'014
114	Nepal	4.37	2.66	8.37	730
115	Angola	4.66	19.47	21.96	5'010
116	Timor-Leste	4.71	14.04	22.43	3'580
117	Micronesia	4.77	13.63	-	3'430
118	Kenya	4.96	3.84	8.37	930
119	Brazil	4.96	48.32	58.11	11'690
120	Moldova	4.97	10.18	22.24	2'460
121	Morocco	5.18	13.09	26.33	3'030
122	Bolivia	5.38	11.43	25.46	2'550
123	Kyrgyzstan	5.42	5.42	14.17	1'200
124	Fiji	5.56	20.54	30.25	4'430
125	Bulgaria	5.67	33.23	63.82	7'030
126	El Salvador	5.78	17.93	34.14	3'720
127	Lao P.D.R.	5.86	7.13	17.84	1'460
128	Marshall Islands	6.35	22.22	-	4'200
129	Samoa	6.36	18.17	22.29	3'430
130	Swaziland	6.59	16.92	36.31	3'080
131	Honduras	7.49	13.61	25.96	2'180
132	Guatemala	7.75	21.58	41.86	3'340
133	Cambodia	7.92	6.27	16.16	950
134	Belize	8.06	31.30	53.83	4'660
135	Albania	8.10	31.73	58.13	4'700
136	Kiribati	8.30	18.12	-	2'620
137	Ethiopia	8.83	3.46	9.19	470
138	Vanuatu	9.92	25.88	20.64	3'130
139	Afghanistan	10.07	5.87	16.51	700
140	S. Tomé & Principe	10.32	12.64	20.03	1'470
141	Cape Verde	10.38	31.40	54.55	3'630
142	Rwanda	12.39	6.40	15.57	620
143	Lesotho	12.50	16.15	37.53	1'550
144	Solomon Islands	13.22	17.74	16.65	1'610
145	Côte d'Ivoire	14.11	16.23	33.91	1'380
146	Zambia	14.31	17.64	34.52	1'480
147	Haiti	14.46	9.76	18.83	810
148	Mauritania	15.97	14.10	-	1'060
149	Papua New Guinea	16.09	26.95	-	2'010
150	Cameroon	16.70	17.67	37.40	1'270
151	Tanzania	17.85	9.37	21.20	630
152	Nicaragua	18.54	27.50	67.07	1'780
153	Senegal	18.58	16.57	33.73	1'070
154	Burkina Faso	20.90	11.67	25.74	670
155	Benin	20.91	13.77	29.06	790
156	Uganda	22.14	9.41	22.16	510
157	Mozambique	25.91	12.74	24.04	590
158	Mali	26.54	14.82	32.61	670
159	Zimbabwe	29.75	20.33	-	820
160	Eritrea	31.84	13.00	-	490
161	Niger	34.37	11.74	25.56	410
162	Burundi	36.56	8.53	22.13	280
163	Togo	38.47	16.99	35.84	530
164	Central African Rep.	51.63	13.77	24.50	320
165	Madagascar	52.55	19.27	55.50	440
166	Malawi	56.29	12.67	40.13	270
	Argentina**	-	33.03	-	-

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

Mobile-cellular services are very affordable in most developed countries, corresponding to less than 2 per cent of GNI p.c. in the majority of them. The exceptions are Moldova (5.0 per cent of GNI p.c.), Bulgaria (5.7 per cent) and Albania (8.1 per cent), where mobile-cellular services are the least affordable in the developed world. This suggests that cost may be a barrier for further uptake of mobile-cellular services in these countries, and therefore requires regulatory and policy attention.

4.3 Broadband prices

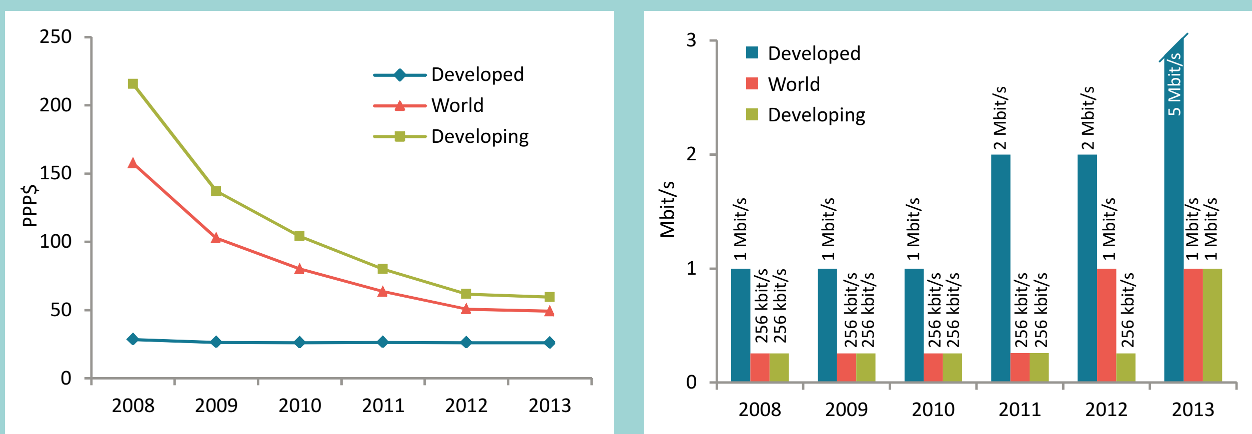
Fixed broadband

Fixed broadband continues to be a critical service for accessing high-speed, high-capacity and reliable Internet services. Despite the growth of mobile-broadband subscriptions, less than 3 per cent of global IP traffic corresponded to mobile networks by end 2013 according to CISCO estimates (CISCO, 2013). Until deployments of advanced mobile-broadband technologies[13] become more widespread, fixed broadband remains the de facto option for accessing high-volume Internet applications such as file sharing (less than 1 per cent of total file-sharing traffic was transmitted through mobile networks in 2013) and Internet video (2 per cent of total Internet video traffic was transmitted through mobile networks in 2013). Therefore, some of the potential benefits of broadband as a development enabler, such as for instance its use in education (see Featured Insight 10 in Broadband Commission, 2013a), depend on fixed-broadband uptake in the near future. In addition, CISCO estimates that 45 per cent of total mobile data traffic was offloaded onto fixed networks in 2013 (CISCO, 2014), highlighting the role that fixed broadband plays in supporting the growth in mobile-broadband networks.

In the period 2008-2013, the price of an entry-level fixed-broadband plan decreased by almost 70 per cent globally: from an average of PPP$ 157.7 in 2008 to PPP$ 49.2 in 2013 (Chart 4.3).[14] In parallel with the reduction in prices, there was a notable increase in the advertised speed for fixed-broadband plans: 256 kbit/s was the most common entry-level speed in 2008, compared with 1 Mbit/s in 2013.

The decrease in fixed-broadband prices was remarkable in developing countries, where

Chart 4.3: Fixed-broadband prices in PPP$ (left) and most common entry-level fixed-broadband speed (right), world and by level of development, 2008-2013



Note: Simple averages in the case of the fixed-broadband prices; mode in the case of the entry-level fixed-broadband speeds. Based on 143 economies for which 2008-2013 data on fixed-broadband prices were available.
Source: ITU.

average prices dropped by 70 per cent in the five-year period, down to PPP$ 59.4 (or USD 34.1) in 2013. The fall in prices was particularly strong in the period 2008-2012, with the average price in developing countries declining by more than 20 per cent per year (-25 per cent CAGR in 2008-2012). In 2013, there was a slowdown, with the average entry-level fixed-broadband price in developing countries decreasing by only 4 per cent. Indeed, the countries with the most expensive fixed-broadband prices, such as Papua New Guinea, Rwanda and Vanuatu (all of them with entry-level fixed-broadband services costing more than USD 100) saw little improvement in prices in 2013. On the other hand, there was an upgrade of entry-level fixed-broadband speeds in developing countries in 2013, with 1 Mbit/s becoming the most common entry-level speed, as opposed to 256 kbit/s in 2012. This suggests operators in several developing countries focused their efforts on improving the speed rather than the price of fixed-broadband entry-level plans in 2013.

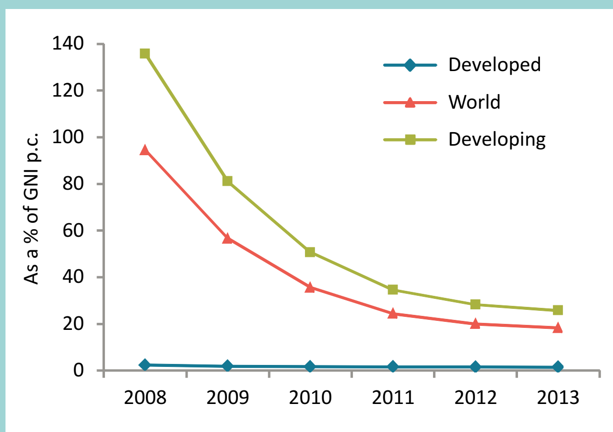
Entry-level fixed-broadband prices remained much more stable in developed countries, and registered only a slight decrease in the period 2008-2013 (-2 per cent CAGR), to an average of PPP$ 26.0 (or USD 25.5). The almost flat evolution of entry-level fixed-broadband prices in the developed world suggests that competition in the market is centred around higher-end users contracting higher speeds and/or fixed broadband bundled with other services. This is in line with the findings on bundle adoption from household surveys (European Commission, 2014) and data on fixed (wired)-broadband subscriptions by speed, which show that a significant share of fixed (wired)-broadband subscriptions in developed countries had advertised speeds equal to or greater than 10 Mbit/s (ITU, 2014).

Nevertheless, entry-level fixed-broadband prices in developed countries still remained significantly less expensive on average than in developing countries in 2013: less than half the price in PPP$, and 25 per cent cheaper in terms of USD. In addition, differences in the quality of the connection persisted: the most common advertised speed for entry-level fixed-broadband plans was 5 Mbit/s in developed countries in 2013, as against 1 Mbit/s in developing countries. Therefore, despite paying more for an entry-level fixed-broadband plan, customers in developing countries are getting a connection five times slower on average than that enjoyed by customers in developed countries.

In line with the reduction of fixed-broadband prices in PPP$ and USD, entry-level fixed-broadband plans are becoming more and more affordable: they fell from an average price of 94.5 per cent of GNI p.c. in 2008 to 18.3 of GNI p.c. in 2013 (Chart 4.4).

The biggest increase in affordability occurred in developing countries between 2008 and 2011, where the average price (relative to GNI p.c.) for an entry-level fixed-broadband plan was divided by four. In 2012 and 2013, prices in developing countries remained more stable, suggesting that operators' efforts were focused on improving the quality of the service. Despite the progress made in improving the affordability of fixed-broadband services, the average price for an entry-level fixed-broadband plan still represented

Chart 4.4: Fixed-broadband prices, as a percentage of GNI p.c., world and by level of development, 2008-2013



Note: Simple averages. Based on 143 economies for which 2008-2013 data on fixed-broadband prices were available.
Source: ITU.

25.8 of GNI p.c. in the developing world at end 2013. Moreover, in most developing countries fixed broadband costs more than 5 per cent of GNI p.c. More progress is therefore needed to achieve the affordability target set by the Broadband Commission for Digital Development: "By 2015, entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces (amounting to less than 5% of average monthly income)" (Broadband Commission, 2011).

By contrast, entry-level fixed-broadband prices were already well below 5 per cent of GNI p.c. in a large majority of developed countries in 2008. The decrease in prices in Albania, Serbia and Ukraine in the period 2008-2013 has left Moldova as the only developed country with entry-level fixed-broadband prices above 5 per cent of GNI p.c. (Table 4.4). These price reductions were reflected in the average value for developed countries, which experienced a consecutive annual decline of 15 per cent in the period 2008-2010, down to 1.6 per cent of GNI p.c. by end 2010. From 2010 to 2013, the average price for entry-level fixed-broadband plans in developed countries stagnated, while fixed-broadband penetration continued to increase, albeit at a slower pace (7.3 per cent CAGR in 2008-2010, compared with 4.2 per cent CAGR in 2010-2013). This suggests that competition is taking place in other (higher-end) segments of the market, and that price is less of a barrier to adoption in developed countries. The latter conclusion is confirmed by the findings from household surveys (European Commission 2013).

Regional analysis

A regional comparison of fixed-broadband prices reveals huge differences across regions as well as within regions (Table 4.3).

Europe is the region with the most affordable fixed-broadband plans, European countries exhibiting prices that correspond to between 3.8 and 0.5 of GNI p.c. in 2013. Some of the countries with the most affordable fixed-broadband prices in the world are from Europe, including the United Kingdom, Switzerland, Ireland and Norway (Chart 4.5). Switzerland has the highest fixed (wired)-broadband penetration in the world, and the United Kingdom and Norway are also among the world's top countries in terms of broadband penetration. The low prices in Ireland are linked to the extensive fibre roll-out implemented by the incumbent operator Eircom. Indeed, customers in most urban areas of Ireland can subscribe to FTTH services, thus benefiting from Internet access at high speeds (50 Mbit/s) for as little as USD 19.9 in addition to the cost of the fixed-line rental.[15]

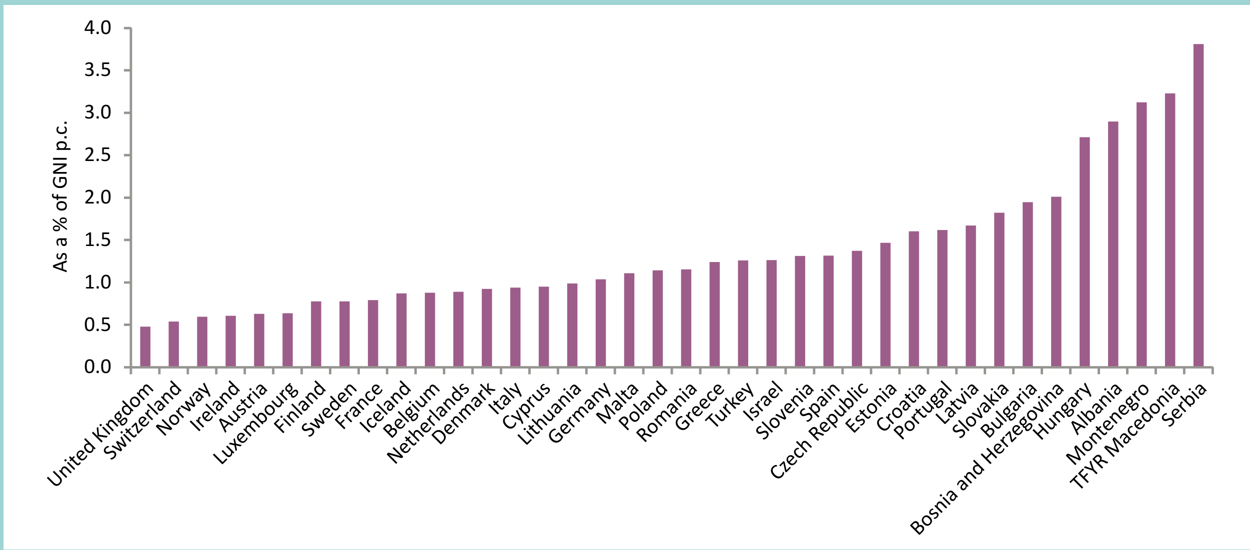
The countries with the least affordable prices in Europe are Albania (2.9 per cent of GNI p.c.), Montenegro (3.1 per cent of GNI p.c.), TFYR Macedonia (3.2 per cent of GNI p.c.) and Serbia (3.8 per cent of GNI p.c.), all of which nonetheless meet the 5 per cent affordability target set by the Broadband Commission. Moreover, entry-level fixed-broadband prices in these countries are in the range USD 11 to USD 19, and hence relatively low considering they offer speeds of at least 2 Mbit/s.

Table 4.3: Fixed-broadband prices as a percentage of GNI p.c., by region, 2013

Region	Average	Standard deviation	Minimum	Maximum	Median
Europe	1.4	0.8	0.5	3.8	1.1
CIS	3.8	3.4	0.5	11.9	2.8
Arab States	4.1	5.9	0.4	23.7	2.0
The Americas	9.0	17.5	0.7	85.8	4.6
Asia & Pacific	23.7	56.7	0.3	266.0	5.0
Africa	135.8	382.1	0.8	2'193.6	42.1

Note: Based on 165 economies for which 2013 data on fixed-broadband prices were available.
Source: ITU.

Chart 4.5: Fixed-broadband prices as a percentage of GNI p.c. in Europe, 2013

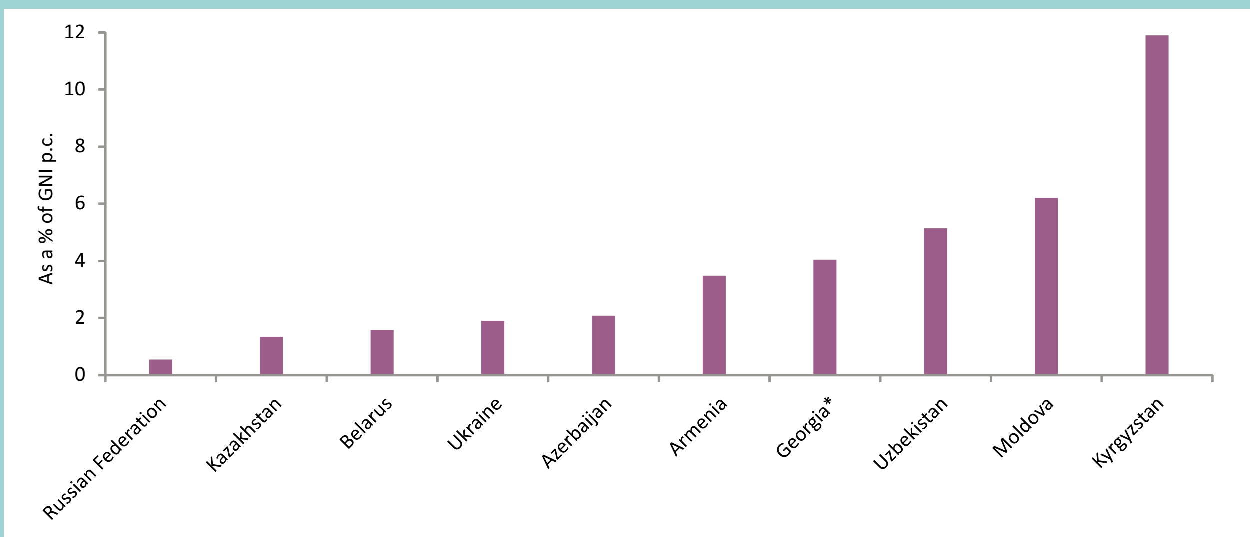


Source: ITU. GNI p.c. values are based on World Bank data.

The region with the second most affordable entry-level fixed-broadband services is the **Commonwealth of Independent States**, with an average price corresponding to 3.8 per cent of GNI p.c. The differences within the region are slightly larger than in Europe, CIS countries having fixed-broadband prices that represent between 0.5 and 11.9 per cent of GNI per capita (Chart 4.6).

The Russian Federation has the most affordable entry-level fixed-broadband prices in the region, corresponding to 0.5 per cent of GNI p.c. This is explained not only by the country's relatively

Chart 4.6: Fixed-broadband prices as a percentage of GNI p.c. in the CIS, 2013



Note: Until 2009, the CIS region included the above countries. Georgia exited the Commonwealth on August 18, 2009, but is included in this report.
Source: ITU. GNI p.c. values are based on World Bank data.

high gross national income (the highest in the CIS), but also by the low prices: USD 6.3 for a fixed-broadband plan at 5 Mbit/s, the lowest price in the region. Several large operators compete in the Russian fixed-broadband market, taking advantage of the economies of scale built up in different regional and local markets. As a result, a number of operators have achieved a significant volume of fixed-broadband subscriptions, including the incumbent Rostelecom, Mobile TeleSystems OJSC (MTS) and ER-Telecom. The national fixed-broadband market in the Russian Federation is thus one of the most de-concentrated in the world.

All CIS countries included in the analysis have fixed-broadband prices below the 5 per cent affordability threshold, except for Uzbekistan (5.1 per cent of GNI p.c.), Moldova (6.2 per cent) and Kyrgyzstan (11.9 per cent). In the case of Uzbekistan, prices are relatively cheap (USD 8.1), but GNI per capita is very low. It is to be expected that the target will be met there by end 2015 if fixed-broadband prices are maintained and economic growth continues. However, policy and regulatory action will be necessary to step up a gear in broadband adoption, since fixed (wired)-broadband penetration in Uzbekistan stood at only 1.1 per cent at end 2013. Limited international connectivity is one of the important bottlenecks to be addressed in the Uzbek broadband market, where there was only 20 000 Mbit/s of international Internet bandwidth to share among more than 300 000 fixed (wired)-broadband subscriptions in 2013. The scarcity of international Internet bandwidth is further confirmed by the fact that the entry-level plan in Uzbekistan is capped at 1.2 GB of usage per month, whereas in most CIS countries fixed-broadband plans allow unlimited usage. Future growth in broadband adoption would require an increase in international connectivity.

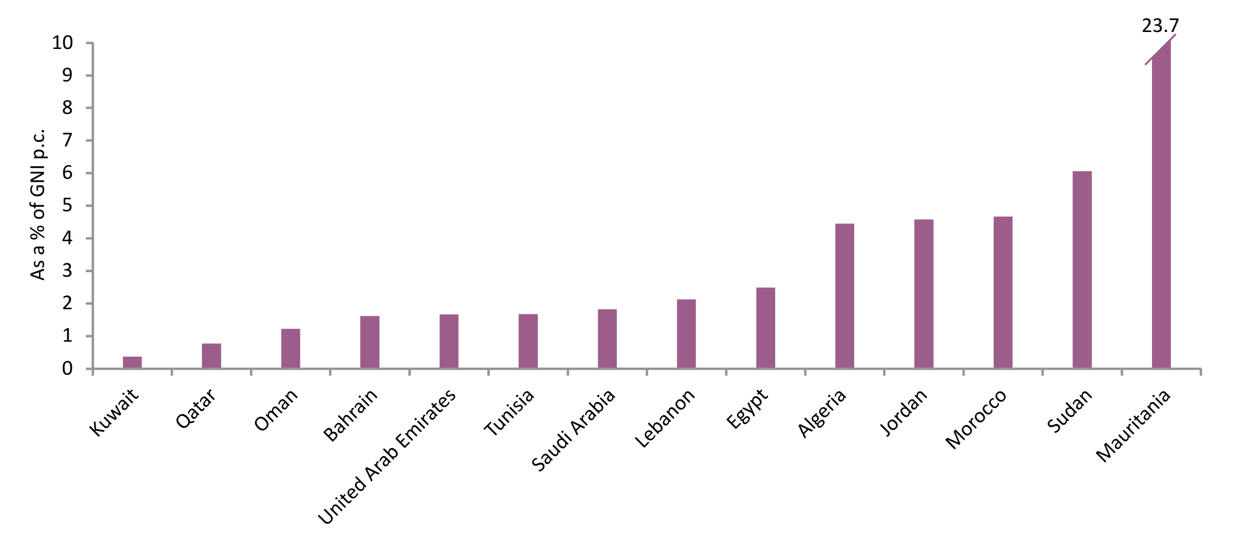
Moldova has the most expensive entry-level fixed-broadband prices in the region, together with Azerbaijan (both USD 12.7), but Moldova has a much lower GNI p.c. and therefore services are less affordable. The relatively high prices in Moldova are explained by the characteristics of the fixed-broadband plan offered by Moldtelecom, which is based on FTTx technology, cheaper than the ADSL offers in the country, and has an advertised speed of 20 Mbit/s. This is by far the fastest speed for an entry-level broadband plan in the CIS.

Kyrgyzstan stands out as the country with the least affordable fixed-broadband prices in the CIS, corresponding to 11.9 per cent of GNI p.c. This suggests that affordability may be a determining factor for the low fixed-broadband penetration in the country (1.0 per cent by end 2013). Being a landlocked country like Uzbekistan, Kyrgyzstan also faces a lack of international connectivity, with 5 000 Mbit/s to be shared by more than 53 000 fixed (wired)-broadband subscriptions. In addition, the fixed-broadband market in the country has a limited number of facilities-based ISPs and is relatively concentrated, dominated by Kyrgyz Telecom. These factors suggest that regulatory measures to promote competition and ease the international connectivity bottleneck could help drive prices down to the levels achieved in other CIS countries, such as the Russian Federation and Ukraine, where entry-level fixed-broadband plans cost less than USD 7 (compared with almost USD 12 in Kyrgyzstan).

The average price for an entry-level fixed-broadband plan in the **Arab States** corresponds to 4.1 per cent of GNI per capita, slightly higher than in the CIS. Differences within the region are wider, however, countries in the region having prices that represent between 23.7 and 2.0 of GNI p.c.

The high-income Gulf Cooperation Council (GCC) countries have the most affordable fixed-broadband prices, along with Tunisia (Chart 4.7). Tunisie Telecom offers regular ongoing promotions for ADSL services with some of the most advantageous prices in the region: USD 6.1, by far the cheapest price offered by an incumbent operator in the Arab States for an Internet service at speeds above 512 kbit/s. The relatively low fixed (wired)-broadband

Chart 4.7: Fixed-broadband prices as a percentage of GNI p.c. in the Arab States, 2013



Source: ITU. GNI p.c. values are based on World Bank data.

penetration in Tunisia (4.8 per cent by end 2013) suggests that efforts need to be focused on extending the reach of the ADSL network in order to make available such affordable fixed-broadband prices to more areas in the country, and on improving ICT skills and promoting relevant local content in Arabic.[16]

Kuwait stands out as the country with the most affordable fixed-broadband prices in the region (0.4 per cent of GNI p.c.), which indeed places it second in the world ranking. The low prices offered by Kuwait's leading fixed ISP Qualitynet[17] are in sharp contrast with the very low fixed (wired)-broadband penetration in the country: 1.4 per cent by end 2013. This may be explained by the limited coverage of Qualitynet, which suggests the need for more investment in broadband network equipment and network roll-out to enable the take-off of fixed-broadband services in Kuwait.

Mauritania is the Arab country where entry-level fixed-broadband prices are the least affordable. Indeed, an entry-level fixed broadband-plan corresponded to 23.7 per cent of GNI p.c. in 2013, thus pointing to affordability as a major barrier for fixed-broadband uptake in the country. This may be an explanatory factor for the low fixed (wired)-broadband penetration in Mauritania: 0.2 per cent by end 2013, the second lowest in the region after Sudan's. Policy and regulatory actions to address the challenge of unaffordable fixed-broadband services would need to target both the supply and the demand sides (Box 4.1).

The average price for an entry-level fixed-broadband plan in the **Americas** region corresponds to 0.6 per cent of GNI per capita, more than twice as much as in the Arab States and CIS, but lower than in Asia and the Pacific. Differences within the region are significant, countries lying in the range 0.7 to 85.8 per cent of GNI p.c. The median price corresponds to 4.6 per cent of GNI p.c., which means that half of the countries in the region have prices below that value.

The United States is the country with the most affordable entry-level fixed-broadband services in the region (0.7 of GNI p.c.), and the second in terms of fixed (wired)-broadband penetration, after Canada, with 29 and 33 fixed (wired)-broadband subscriptions per 100 inhabitants,

Box 4.1: Challenges for fixed-broadband adoption in Mauritania

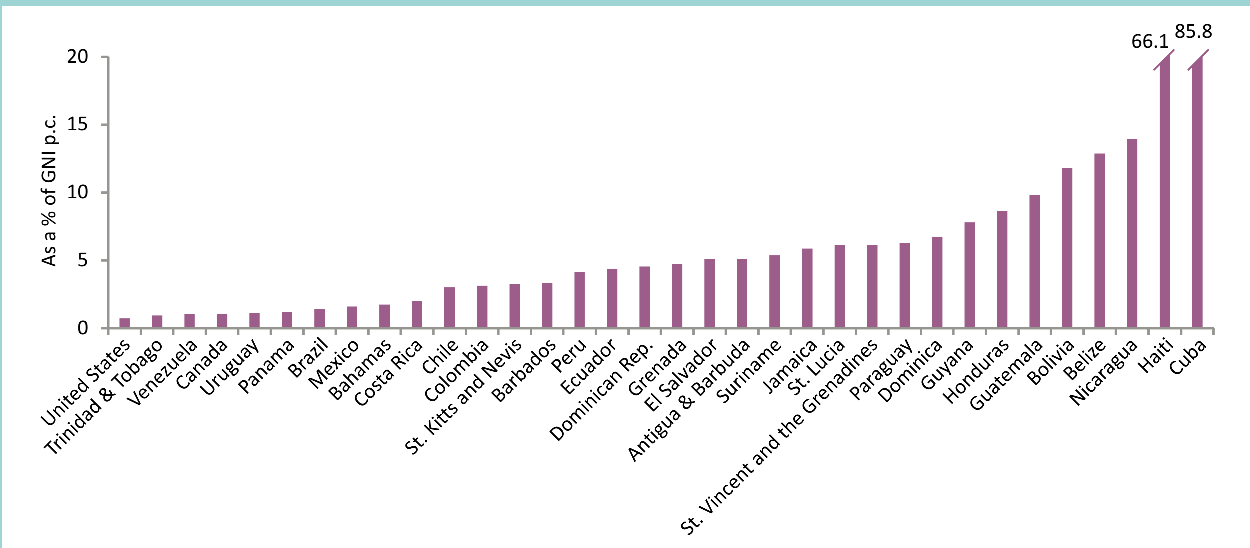
Unaffordable fixed-broadband services in Mauritania are the result of factors on both the supply and the demand side.

On the supply side, there are only two facilities-based fixed-broadband operators in the market, with the incumbent Mauritel largely dominating it.[18] Moreover, international Internet bandwidth is very limited in the country: 620 Mbit/s in 2013, more than 40 times less than any other Arab country included in the comparison of fixed-broadband prices. This means that if one-third of fixed (wired)-broadband subscriptions in Mauritania try to access the international Internet at the same time, they will have on average a speed below 256 kbit/s, i.e. narrowband speed. Taking into account that fixed (wired)-broadband penetration is below 0.2 per cent in the country, international connectivity could be a major bottleneck for future broadband growth. Regulatory interventions to promote competition and to improve international connectivity could greatly contribute to stimulating the fixed-broadband market.

On the demand side, GNI per capita in Mauritania is the lowest of all Arab countries included in the comparison of fixed-broadband prices. In order to reach the 5 per cent affordability target, an entry-level fixed-broadband plan would have to cost USD 4.4 in Mauritania. Such low fixed-broadband prices are only available in Bangladesh, Sri Lanka and Viet Nam, the countries with the cheapest entry-level fixed-broadband plans in USD in the world. In order to advance towards such a challenging target, public policies to support demand for fixed-broadband services could lead to wider adoption and thus give a positive signal to operators. These could include, inter alia, special subsidized plans for low-income households or the promotion of public Internet access centres (based on either commercial or public schemes).

Source: ITU.

Chart 4.8: Fixed-broadband prices as a percentage of GNI p.c. in the Americas, 2013



Source: ITU. GNI p.c. values are based on World Bank data.

respectively. The affordability of fixed-broadband prices in North America was to be expected, given the high GNI per capita levels and the advanced level of ICT development in the United States and Canada.

Countries in the Americas region with relatively affordable fixed-broadband plans include Trinidad and Tobago, Venezuela and Uruguay (Chart 4.8). Trinidad and Tobago is the Caribbean country that has experienced the highest growth in fixed (wired)-broadband penetration in the period 2010-2013 (7 per cent CAGR), pointing to the importance of affordable entry-level plans for promoting fixed-broadband uptake. In Venezuela, the government-owned incumbent, CANTV, offers affordable fixed-broadband services, including prepaid plans, starting at USD 10.9 for unlimited monthly usage, the cheapest prices in USD in the Americas together with those in Panama (USD 10.7). However, the country still has plenty of room for further broadband adoption, since fixed-broadband penetration stood at 7.3 per cent by end 2013. Uruguay had entry-level fixed-broadband plans almost as affordable as Venezuela's (corresponding to 1.1 and 1.0 per cent of GNI p.c., respectively). Uruguay being a much smaller country than Venezuela in terms of size and population, the low prices had a much greater impact on its fixed-broadband penetration, which doubled in the last three years, climbing to 21 per cent by end 2013, the highest in South America. Taking into account the policy actions being implemented in the framework of the *"Agenda digital Uruguay 2011-2015"* – which include specific entry-level fixed-broadband plans offered by the state-owned telecom operator ANTEL (ITU, 2013a) – Uruguay could aspire to reaching the fixed (wired)-broadband penetration levels of developed countries (27 per cent on average by end 2013).

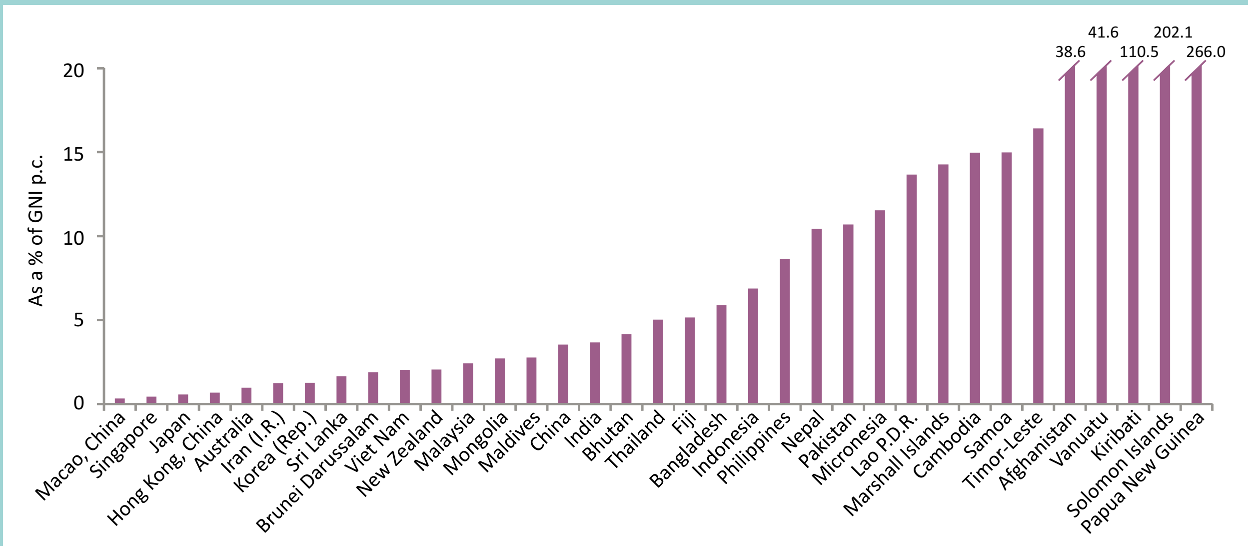
Of the 16 countries in the Americas with fixed-broadband prices above the 5 per cent affordability threshold, Antigua and Barbuda, Belize, Cuba, Haiti and Suriname stand out for having high entry-level prices (costing more than USD 40). Fixed-broadband services in these countries cost more than in the United States, despite the difference in income. This suggests that in all these countries there is plenty of room on the supply side to offer lower prices. Regulatory and policy action could contribute to the process by proposing innovative solutions, such as public-private partnerships to expand the wired broadband infrastructure. This may be particularly necessary in countries like Haiti, where the 2010 earthquake damaged part of the already limited fixed wired infrastructure. In addition, lack of international connectivity would be an issue for future broadband adoption in Belize and Cuba. In the case of Cuba, ADSL subscriptions are still priced as premium services with similar tariffs as leased lines. As a result, dial-up (narrowband) Internet remains the de facto technology for Internet access by residential customers in the island.[19]

Asia and the Pacific is a region exhibiting striking contrasts in fixed-broadband prices, with the average price corresponding to 23.7 per cent of GNI p.c. and prices ranging from 0.3 per cent in Macao (China) to over 100 per cent in Kiribati, Solomon Islands and Papua New Guinea.

It is home to the economy with the most affordable entry-level fixed-broadband plans, Macao (China), where a fixed-broadband service costs less than 0.4 per cent of GNI p.c. (Chart 4.9). Other high-income economies in the region, such as Singapore and Japan – with fixed-broadband prices corresponding to 0.4 and 0.6 per cent of GNI p.c., respectively – also feature among the global top ten. Moreover, entry-level plans in Singapore and Japan offer outstanding speeds: 25 Mbit/s and 12 Mbit/s, respectively. This is also the case in Hong Kong (China) (0.7 per cent of GNI p.c. for a plan at 8 Mbit/s) and the Republic of Korea (1.4 per cent of GNI p.c. for a plan at 50 Mbit/s). These examples show that high-speed broadband at affordable prices is possible if there is strong policy leadership and the engagement from the private sector.

Asia and the Pacific is also home to the countries with the lowest entry-level fixed-broadband prices in USD: Viet Nam (USD 2.9), Sri Lanka (USD 4.3), Bangladesh (USD 4.4) and India (USD 4.8). Although they are not at the top when prices are measured in relative terms on account of their level of GNI p.c., the entry-level fixed-broadband prices achieved in these countries are outstandingly low, and there is little margin for price reduction. These prices are available in the main urban areas, and therefore part of the challenge may be making these offers available to all inhabitants in the country, particularly in Bangladesh, India and Sri Lanka where fixed (wired)-broadband penetration was below 2 per cent in 2013. Sustained initiatives to promote ICT skills in these countries could also contribute to promoting fixed-broadband uptake.[20]

Chart 4.9: Fixed-broadband prices as a percentage of GNI p.c. in Asia and the Pacific, 2013



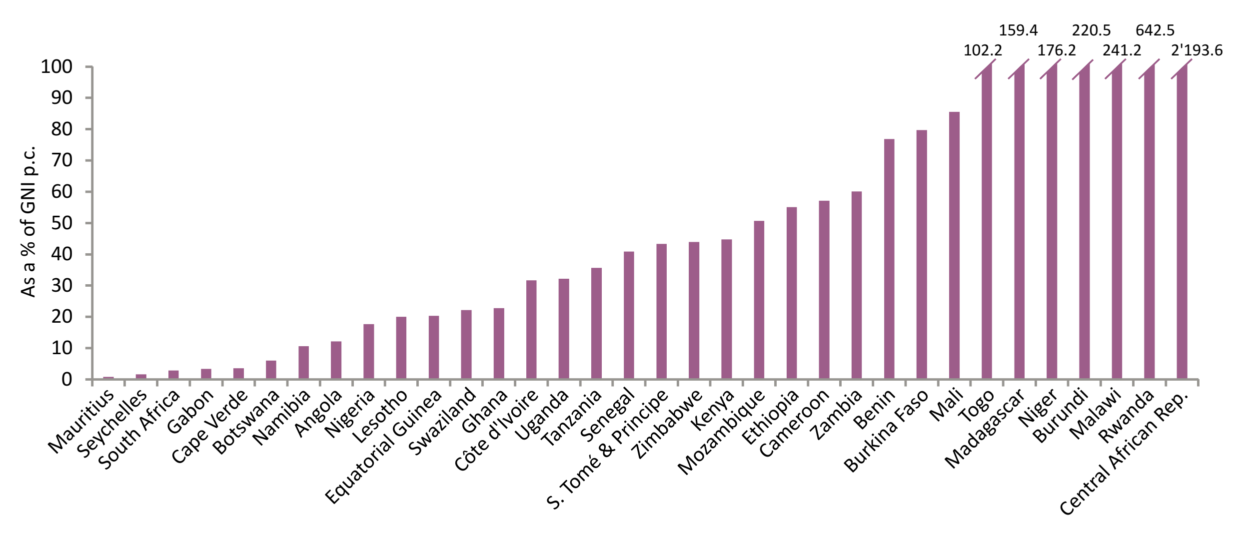
Source: ITU. GNI p.c. values are based on World Bank data.

There are 13 countries in the Asia and the Pacific region where entry-level fixed-broadband plans cost more than 10 per cent of GNI p.c. These include some large countries, such as Pakistan and the Philippines, and several small island developing states (SIDS) in the Pacific. A stronger policy impetus would be necessary for these countries to reach the affordability target of 5 per cent of GNI p.c. set by the Broadband Commission for 2015. Because of their geographic situation, one of the main challenges facing these countries is international Internet bandwidth. Indeed, the latest data on international connectivity show that this may remain an issue in Kiribati (45 Mbit/s), Marshall Islands (45 Mbit/s), Micronesia (45 Mbit/s), Samoa (135 Mbit/s), Solomon Islands (216 Mbit/s), Timor-Leste (178 Mbit/s) and Vanuatu (60 Mbit/s). In several of these countries, it would not be possible to offer the entry-level fixed-broadband plan available in the Republic of Korea (advertised speed of 50 Mbit/s) to even one customer. Since this is a problem shared by many SIDS in the Pacific, a common approach might be an efficient solution to help overcome it, e.g. by concentrating international traffic in a regional Internet exchange point and sharing the cost of building a high-capacity international link from there.

Africa is by far the region with the least affordable fixed-broadband prices, with the average price representing more than 100 per cent of GNI per capita. In seven African countries (20 per cent of those included in the price benchmark), fixed-broadband plans cost more than 100 per cent of GNI p.c. (Chart 4.10). This is in line with the low fixed (wired)-broadband penetration in the region (0.4 per cent on average by end 2013).

The unaffordability of fixed-broadband prices in Africa is closely linked to the small size of the region's economies and therefore low GNI levels in the region. Half of the African countries included in the price benchmark have a GNI p.c. below USD 1 000, which means that fixed-broadband prices would need to cost less than USD 4.2 to meet the affordability target set by the Broadband Commission for 2015. Worldwide, only one country (Viet Nam) had such low fixed-broadband prices in 2013, suggesting that meeting the target may not be possible given the GNI levels.

Chart 4.10: Fixed-broadband prices as a percentage of GNI p.c. in Africa, 2013



Source: ITU. GNI p.c. values are based on World Bank data.

However, a comparison with other regions shows that it is feasible to improve the affordability of fixed-broadband prices in Africa significantly even if the Broadband Commission target is not met. For example, entry-level fixed-broadband prices cost less than USD 20 in 65 countries worldwide (39 per cent of the total included in the price benchmark), and most of these countries are in the developing world. In Africa, only Mauritius (USD 6.5), Cape Verde (USD 10.7), Uganda (USD 13.7), Seychelles (USD 16.7), South Africa (USD 17.1) and Tanzania (USD 18.7) have prices below USD 20. If entry-level fixed-broadband prices at USD 20 were offered in the remaining African countries, the average price would be reduced to an equivalent of 25.8 per cent of GNI p.c., and there would be no countries in the region where fixed broadband would represent more than 100 per cent of GNI p.c.

As several international submarine cables have become operational in Africa, along both the East coast (e.g. TEAMS in 2009, EASSy in 2010)[21] and the West coast (e.g. WACS and ACE in 2012),[22] the bottleneck in the broadband chain may have moved a step onwards in Africa. Regulatory action to open the international gateways to competition and to facilitate backhaul (e.g. by setting a reference offer for the leased lines of the incumbent that provide connectivity to the landing station) could lower barriers to entry in the market, and stimulate competition in broadband services. This would contribute to opening up fixed-broadband markets to competition in Africa, and alter the status quo in several African countries, where the market is concentrated in a single operator. With the exception of micro states and small islands, fixed-broadband markets have been opened to a much larger degree of competition in other regions, to the benefit of customers.

Entry-level fixed-broadband prices are below the 5 per cent affordability threshold in five African countries: Mauritius (0.8 per cent of GNI p.c.), Seychelles (1.6 per cent), South Africa (2.9 per cent), Gabon (3.4 per cent) and Cape Verde (3.5 per cent). Mauritius and Seychelles are the African countries with the highest fixed (wired)-broadband penetration, both having almost reached 13 per cent. These results are explained by the countries' relatively strong economies and therefore high GNI levels, coupled with their low fixed-broadband prices.

Table 4.4: Fixed-broadband sub-basket, 2013

Rank	Economy	Fixed-broadband sub-basket as % of GNI p.c.	Fixed-broadband sub-basket USD	Fixed-broadband sub-basket PPP$	Speed in Mbit/s	Cap per month in GB	GNI p.c., USD, 2013*
1	Macao, China	0.32	17.27	23.37	4	Unlimited	64'691
2	Kuwait	0.37	14.11	21.76	1	Unlimited	45'889
3	Singapore	0.44	19.90	20.58	25	Unlimited	54'040
4	United Kingdom	0.48	15.63	12.80	16	10.0	39'110
5	Switzerland	0.54	36.68	21.86	5	Unlimited	81'760
6	Russian Federation	0.54	6.28	10.95	5	Unlimited	13'860
7	Japan	0.57	21.73	18.89	12	900.0	46'140
8	Norway	0.60	50.89	30.51	2	Unlimited	102'610
9	Ireland	0.61	19.92	15.67	50	30.0	39'501
10	Austria	0.63	25.43	22.10	8	Unlimited	48'590
11	Luxembourg	0.64	38.50	29.04	8	2.0	72'528
12	Hong Kong, China	0.68	21.66	27.85	8	Unlimited	38'420
13	United States	0.73	32.65	32.65	1	Unlimited	53'670
14	Qatar	0.77	54.95	74.67	1	Unlimited	85'550
15	Finland	0.77	30.41	22.88	10	Unlimited	47'110
16	Sweden	0.78	38.23	27.36	10	Unlimited	59'130
17	France	0.79	27.88	23.76	8	Unlimited	42'250
18	Mauritius	0.84	6.51	10.53	0.26	2.0	9'300
19	Iceland	0.87	31.84	26.35	12	1.0	43'930
20	Belgium	0.88	33.13	28.15	30	100.0	45'210
21	Netherlands	0.89	35.19	29.68	8	Unlimited	47'440
22	Denmark	0.92	47.01	31.27	20	Unlimited	61'110
23	Trinidad & Tobago	0.93	12.28	15.41	0.25	Unlimited	15'760
24	Italy	0.94	26.94	24.25	7	Unlimited	34'400
25	Cyprus	0.95	21.12	22.78	2	Unlimited	26'654
26	Australia	0.97	53.10	35.71		Unlimited	65'520
27	Lithuania	0.99	11.50	16.54	50	Unlimited	13'958
28	Germany	1.04	39.77	36.40	16	Unlimited	46'100
29	Venezuela	1.04	10.91	13.77	1	Unlimited	12'550
30	Canada	1.05	45.59	36.32	5	20.0	52'200
31	Malta	1.11	18.40	21.49	4	25.0	19'927
32	Uruguay	1.11	14.06	15.47		5.0	15'180
33	Poland	1.14	12.34	20.28	0.5	Unlimited	12'960
34	Romania	1.15	8.71	14.09	50	Unlimited	9'060
35	Panama	1.20	10.69	18.19	1	Unlimited	10'700
36	Oman	1.22	26.01	49.69	2	Unlimited	25'503
37	Iran (I.R.)	1.24	5.97	12.84	0.256	2.0	5'780
38	Greece	1.24	23.32	24.21	4	Unlimited	22'530
39	Turkey	1.26	11.50	16.62	1	1.0	10'950
40	Israel	1.26	35.95	29.85	5	Unlimited	34'120
41	Korea (Rep.)	1.27	27.40	32.78	50	Unlimited	25'920
42	Slovenia	1.31	25.23	28.14	1	Unlimited	23'058
43	Spain	1.31	31.97	31.33	1	5.0	29'180
44	Kazakhstan	1.34	12.69	21.49	1	3.0	11'380
45	Czech Republic	1.37	20.64	27.19	2	Unlimited	18'060
46	Brazil	1.42	13.82	16.62	1	Unlimited	11'690
47	Estonia	1.47	21.24	24.72	5	Unlimited	17'370
48	Belarus	1.58	8.83	23.54	1	Unlimited	6'720
49	Mexico	1.60	13.23	18.02	1	25.0	9'940
50	Seychelles	1.60	16.69	23.62	1.02	1.5	12'530
51	Croatia	1.60	17.78	24.11	4	1.0	13'330
52	Bahrain	1.62	26.60	45.35	1	2.0	19'756
53	Portugal	1.62	27.87	30.10	12	30.0	20'670
54	Sri Lanka	1.64	4.34	11.95	2	2.5	3'170
55	United Arab Emirates	1.67	54.19	-	0.51	Unlimited	39'006
56	Latvia	1.67	19.78	25.86	5	Unlimited	14'201
57	Tunisia	1.68	6.09	13.15	2	Unlimited	4'360
58	Bahamas	1.73	29.99	26.37	1	Unlimited	20'806
59	Saudi Arabia	1.82	39.73	81.16	2	Unlimited	26'200
60	Slovakia	1.82	26.38	34.70	5	2.0	17'372
61	Brunei Darussalam	1.89	51.95	78.28	1	Unlimited	33'002
62	Ukraine	1.90	6.26	15.60	5	Unlimited	3'960
63	Bulgaria	1.95	11.40	21.90	15	Unlimited	7'030
64	Costa Rica	2.00	15.90	21.77	0.5	Unlimited	9'550
65	Bosnia and Herzegovina	2.01	7.94	13.84	2	2.0	4'740
66	Viet Nam	2.03	2.93	7.15	2.5	1.0	1'730
67	New Zealand	2.06	61.51	47.78		30.0	35'875
68	Azerbaijan	2.08	12.75	29.51	1	Unlimited	7'350
69	Lebanon	2.13	17.51	-	1	4.0	9'870
70	Malaysia	2.42	20.95	41.52	0.51	Unlimited	10'400
71	Egypt	2.49	6.55	22.04	0.26	2.0	3'160
72	Hungary	2.71	28.34	44.14	10	Unlimited	12'534
73	Mongolia	2.72	8.53	18.16	1	Unlimited	3'770
74	Maldives	2.78	12.95	16.83	2	5.0	5'600
75	South Africa	2.85	17.09	30.26	1	5.0	7'190
76	Albania	2.90	11.35	20.79	2	4.0	4'700
77	Chile	3.02	38.34	48.02	4	Unlimited	15'230
78	Montenegro	3.12	18.89	31.25	1	1.0	7'260
79	Colombia	3.14	19.80	30.41	1	Unlimited	7'560
80	TFYR Macedonia	3.23	12.91	25.72	4	30.0	4'800
81	St. Kitts and Nevis	3.27	36.67	45.20	2		13'460
82	Barbados	3.35	42.50	34.28	6	Unlimited	15'231
83	Gabon	3.42	30.36	41.92	0.51	Unlimited	10'650
84	Armenia	3.48	10.99	23.37		1.0	3'790
85	Cape Verde	3.54	10.72	18.62	2	3.4	3'630
86	China	3.54	19.37	31.92	1	Unlimited	6'560
87	India	3.66	4.79	16.01	2	1.0	1'570
88	Serbia	3.81	18.19	31.56	5	Unlimited	5'730
89	Georgia	4.04	12.02	24.96	5	Unlimited	3'570
90	Peru	4.14	22.05	36.91	1	Unlimited	6'390
91	Bhutan	4.15	8.52	25.67	2	4.0	2'460
92	Ecuador	4.39	20.16	35.33	2	Unlimited	5'510
93	Algeria	4.45	19.60	45.11	0.51	Unlimited	5'290
94	Dominican Rep.	4.54	21.28	40.86	1	Unlimited	5'620
95	Jordan	4.58	18.89	39.36	1	80.0	4'950
96	Morocco	4.66	11.78	23.70	4	Unlimited	3'030
97	Grenada	4.73	29.39	38.38	2	Unlimited	7'460
98	Thailand	5.02	22.46	52.85	13	Unlimited	5'370
99	El Salvador	5.10	15.81	30.10	0.5	Unlimited	3'720
100	Antigua & Barbuda	5.11	54.94	66.85	1	Unlimited	12'910
101	Uzbekistan	5.14	8.14	-	0.26	1.2	1'900
102	Fiji	5.15	19.01	28.00	10	5.0	4'430
103	Suriname	5.38	41.48	70.28	6.14		9'260
104	Jamaica	5.88	25.57	35.84	1	Unlimited	5'220
105	Bangladesh	5.89	4.42	12.59	0.25	2.0	900
106	Botswana	6.05	38.99	-	0.51	Unlimited	7'730
107	Sudan	6.06	5.71	-	0.51	2.0	1'130
108	St. Lucia	6.13	36.20	44.77	2	Unlimited	7'090
109	St. Vincent and the G.	6.14	33.65	44.61	1		6'580
110	Moldova	6.20	12.71	27.76	20	Unlimited	2'460
111	Paraguay	6.29	21.19	38.42	0.75	Unlimited	4'040
112	Dominica	6.73	37.91	50.71	2	Unlimited	6'760
113	Indonesia	6.87	20.50	48.92	0.38	3.0	3'580
114	Guyana	7.79	24.34	-	0.25	Unlimited	3'750
115	Honduras	8.63	15.68	28.40	0.25	Unlimited	2'180
116	Philippines	8.64	23.54	51.59	3	Unlimited	3'270
117	Guatemala	9.83	27.36	53.09	0.5	Unlimited	3'340
118	Nepal	10.43	6.35	20.01	0.5	7.0	730
119	Namibia	10.62	51.68	89.53	0.38	Unlimited	5'840
120	Pakistan	10.70	12.30	43.12	1	Unlimited	1'380
121	Micronesia	11.55	33.00	-	0.25		3'430
122	Bolivia	11.78	25.04	55.76	0.42	Unlimited	2'550
123	Kyrgyzstan	11.89	11.89	31.07	0.5	Unlimited	1'200
124	Angola	12.16	50.76	57.24	0.26	Unlimited	5'010
125	Belize	12.88	50.00	86.01	0.26	Unlimited	4'660
126	Lao P.D.R.	13.67	16.64	41.65	0.5		1'460
127	Nicaragua	13.96	20.70	47.98	0.5	Unlimited	1'780
128	Marshall Islands	14.27	49.95	-	0.25		4'200
129	Cambodia	14.97	11.85	30.55	2	Unlimited	950
130	Samoa	14.99	42.84	52.55	2	3.0	3'430
131	Timor-Leste	16.42	49.00	78.25	0.5	3.0	3'580
132	Nigeria	17.64	40.58	67.39	1	5.0	2'760
133	Lesotho	20.05	25.89	60.18	0.51	4.0	1'550
134	Equatorial Guinea	20.35	242.90	-	0.26	Unlimited	14'320
135	Swaziland	22.19	56.96	122.26	0.26	6.0	3'080
136	Ghana	22.74	33.36	70.12	4	15.0	1'760
137	Mauritania	23.65	20.89	-	0.26	Unlimited	1'060
138	Côte d'Ivoire	31.68	36.43	76.11	0.26	Unlimited	1'380
139	Uganda	32.18	13.68	32.20	0.512	1.0	510
140	Tanzania	35.70	18.74	42.41	0.51	Unlimited	630
141	Afghanistan	38.61	22.52	63.30	0.25	Unlimited	700
142	Senegal	40.86	36.43	74.17	1	Unlimited	1'070
143	Vanuatu	41.60	108.50	86.52	0.25	Unlimited	3'130
144	S. Tomé & Principe	43.35	53.11	83.85	0.51	8.0	1'470
145	Zimbabwe	43.90	30.00	-	0.26	10.0	820
146	Kenya	44.80	34.72	75.58	0.26	Unlimited	930
147	Mozambique	50.67	24.91	47.02	0.51	6.0	590
148	Ethiopia	55.14	21.59	57.40	0.51	2.0	470
149	Cameroon	57.19	60.52	128.08	0.26	Unlimited	1'270
150	Zambia	60.11	74.13	145.03	0.26	Unlimited	1'480
151	Haiti	66.07	44.60	86.07	0.25	Unlimited	810
152	Benin	76.87	50.60	106.80	0.51	Unlimited	790
153	Burkina Faso	79.76	44.53	98.22	0.26	Unlimited	670
154	Mali	85.56	47.77	105.12	2	Unlimited	670
155	Cuba	85.79	430.00	-	0.25	Unlimited	6'014
156	Togo	102.18	45.13	95.20	0.26	Unlimited	530
157	Kiribati	110.54	241.35	-	0.25	Unlimited	2'620
158	Madagascar	159.42	58.45	168.38	8	Unlimited	440
159	Niger	176.25	60.22	131.07	0.26	Unlimited	410
160	Solomon Islands	202.13	271.19	254.52	0.26	6.0	1'610
161	Burundi	220.47	51.44	133.45	0.26	Unlimited	280
162	Malawi	241.25	54.28	171.99	0.26	Unlimited	270
163	Papua New Guinea	265.99	445.53	-	4	Unlimited	2'010
164	Rwanda	642.45	331.93	807.40	0.256	Unlimited	620
165	Central African Rep.	2193.65	584.97	1040.74	0.256	Unlimited	320
	Argentina**	-	40.30	-	3	Unlimited	

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

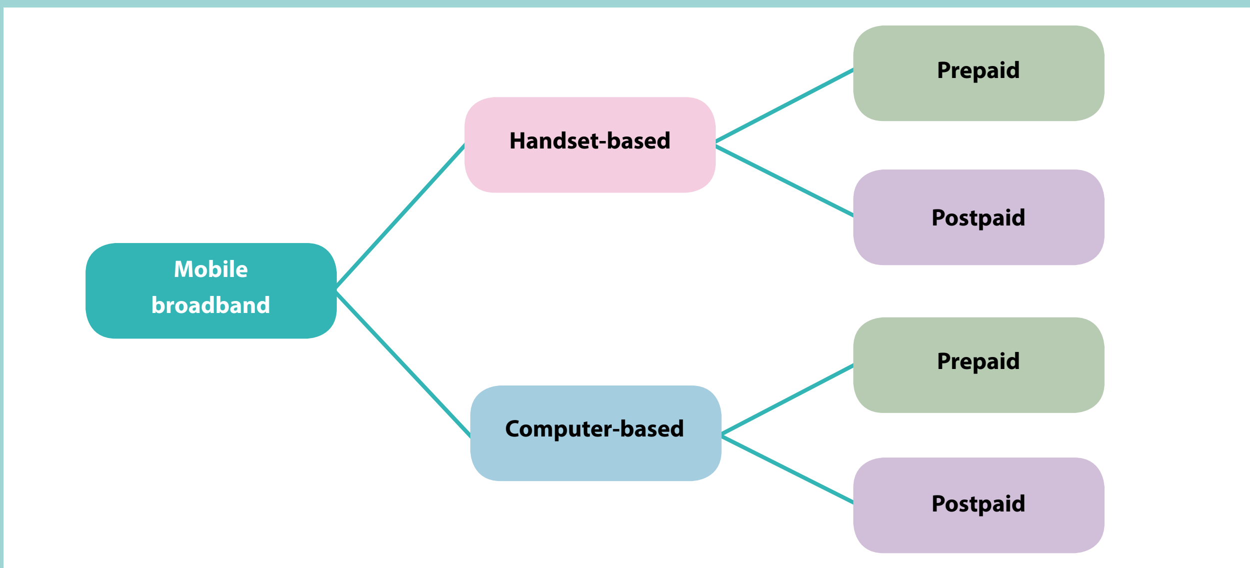
Cape Verde and South Africa are the third and fourth African countries with the highest fixed (wired)-broadband penetration, at 4 and 3 per cent, respectively. Cape Verde was in the list of least developed countries (LDCs) until 2007 and, despite having a lower GNI p.c. than other African countries, stands out for its inexpensive entry-level fixed-broadband prices (USD 10.7), three times lower than in Gabon (USD 30.4). This suggests that Gabon could progress in terms of fixed (wired)-broadband adoption (0.5 per cent penetration by end 2013) if cheaper prices were available. Other countries with higher incomes than Cape Verde that could meet the 5 per cent affordability target by 2015 would be Angola, Botswana, Equatorial Guinea and Namibia. In order to reach that goal, strong policy and regulatory attention to broadband markets would be required.

Mobile broadband

Mobile broadband is the most dynamic telecommunication market, the only one displaying sustained double-digit growth rates since 2008 (Chapter 1). According to ITU estimates, around 50 per cent of the global population are covered by a 3G network, and this figure will grow as more and more mobile-broadband networks are deployed, until eventually 3G coverage approaches mobile-cellular coverage (93 per cent). As 3G networks become ubiquitous and therefore accessible to most of the population, affordability will be one of the most decisive factors for actual uptake of mobile broadband.

The dynamism of the mobile-broadband market is also reflected in prices. Unlike the fixed-broadband market, where price structures are fairly homogenous across countries and stable in time, mobile-broadband prices vary and operators are continuously launching innovative offers to try to attract new customers. On top of the main types of mobile-broadband plans for which ITU collects data on prices (Figure 4.1), operators are adding plans for specific devices, such as tablets, MiFi dongles, BlackBerry, etc. Some operators, like for instance Rogers in Canada and Verizon in the United States, are allowing customers to pool the data consumed by different devices in a single subscription.[23] In addition, handset-based mobile-broadband

Figure 4.1: Mobile-broadband services by type of device/plan



Source: ITU.

plans are often bundled with mobile voice and SMS. This makes it difficult to isolate the prices of mobile-broadband services, particularly for postpaid plans where it is sometimes cheaper to buy a package including Internet, voice and SMS than to contract only Internet.

Fixed-broadband and mobile-broadband Internet prices follow different pricing structures, and therefore the analysis of mobile-broadband prices cannot be based on the same parameters used for fixed broadband. In the case of fixed Internet access, the progress from narrowband (dial-up) to broadband brought not only a change in speed but also in pricing. Dial-up was priced on the basis of usage (usually billed per minute/hour), whereas fixed-broadband Internet usually follows a flat-rate arrangement, whereby the customer pays a monthly fee and has unlimited access to the Internet at a given speed, with neither time nor data volume constraints. This is the common scheme in a vast majority of countries, where fixed-broadband plans are unlimited and the differentiating factor is the speed of the connection (Table 4.4).

Mobile-broadband plans are seldom based on flat-rate schemes, and almost all of them include data volume caps, e.g. USD 10 for 50 MB per month. Several operators also offer advantageous plans based on a combination of time and data volume limitations, e.g. USD 5 for one day of use with a maximum of 50 MB. This reflects the stricter bandwidth constraints of mobile-broadband networks, and particularly the spectrum limitations in the access network. The situation could change in the future if new spectrum is allocated for mobile broadband (for instance, part of the digital dividend) and mobile-broadband networks are upgraded to advanced technologies (such as LTE-Advanced and WirelessMAN-Advanced) that allow more efficient use of spectrum.

Currently, most mobile-broadband plans are priced on the basis of the data allowance (i.e. the data volume in MB included in the plan) and not the speed. Many operators do not even advertise the speed of the mobile-broadband service, but confine themselves to a generic mention of the technology deployed (which provides only an indication of the speed, since the definition of '3.5G' or '4G' may vary across operators). This may also change in the future, as some operators are starting to offer premium plans (at a higher cost) for mobile-broadband services based on high-speed networks. These plans are often labelled as '4G' and may include some indication of the theoretical speeds that can be achieved. This is the case, for instance, of the operator Tigo, which offers premium '4G' plans in Bolivia, Colombia, Guatemala and Paraguay.[24] In any case, mobile-broadband speeds depend on several external factors, such as distance from the base station, location (e.g. inside a building or outside), movement (stationary or in motion) and the number of people concurrently accessing the network in the same area. These factors are difficult to predetermine for service providers, which makes mobile-broadband speeds more difficult to predict than fixed-broadband speeds (see for instance Ofcom, 2011).

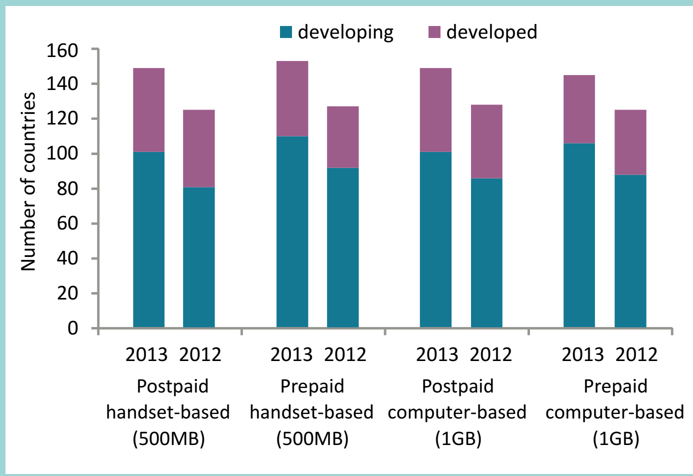
Chart 4.11 shows that mobile-broadband plans are becoming more and more available, particularly in developing countries, where around 20 per cent more countries were offering mobile-broadband plans in 2013 than in 2012. The figures also highlight the difference in the types of plans offered in developed and developing countries: prepaid plans are slightly more available than postpaid plans in developing countries, whereas the opposite is true in developed countries. This tallies with the situation in respect of voice and SMS mobile-cellular services, for which prepaid plans are most popular in the developing world. Globally, the mobile-broadband service available in the most countries is prepaid handset-based, which was offered in 153 countries in 2013. There are far fewer countries (121 in 2013) where all four modalities of mobile-broadband services are offered.

In view of the dynamics of the mobile-broadband market, this section will focus on analysis of the 2013 prices, without comparing them with the 2012 figures. A comparison of mobile-broadband prices across time would reflect the changes in pricing structures (changes in data allowances, bundled voice minutes and SMS, time limitations, premium speeds, etc.) rather than actual differences in prices for the same mobile-broadband service.

The global average price for a computer-based mobile-broadband service with 1 GB monthly data allowance was PPP$ 36.6 (or USD 24.4) for prepaid plans and PPP$ 30.0 (or USD 19.2) for postpaid plans in 2013 (Chart 4.12). The price difference between postpaid and prepaid plans is also found in respect of regular mobile-cellular services, because operators will usually offer lower prices to customers who subscribe to a monthly service, since they generate a more predictable revenue flow. This is particularly true in developed countries, where postpaid computer-based mobile-broadband plans cost 37 per cent less than the corresponding prepaid plans in PPP terms. Differences between prepaid and postpaid computer-based mobile-broadband plans are less marked in developing countries, suggesting that operators differentiate less between postpaid and prepaid offers for the time being.

The average cost for a handset-based mobile-broadband service with 500 MB monthly data allowance was PPP$ 25.3 (or USD 16.9) for prepaid plans and PPP$ 25.7 (or USD 17.6) for postpaid plans in 2013. Prices were cheaper compared with computer-based plans because the monthly data allowance was half as large. Nevertheless, the reduction in price was not proportional to the reduction in the data allowance, confirming that the price per GB is lower for larger data allowances, the equivalent of a volume discount. Unlike in the case of computer-based mobile-broadband services, the prices for postpaid and prepaid handset-based mobile-broadband plans were similar, which means that operators are in most cases offering the same rates to postpaid and prepaid smartphone customers.

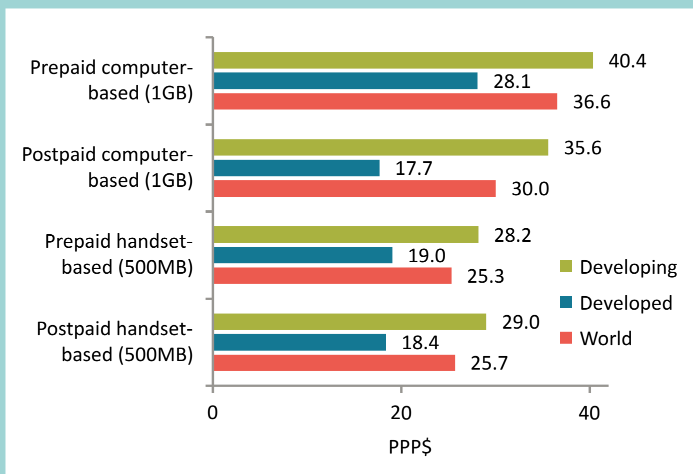
Chart 4.11: Availability of mobile-broadband services by type of service, by level of development, 2013 and 2012



Note: A mobile-broadband service is counted as available if it was advertised on the website of the dominant operator or prices were provided to ITU through the ICT Price Basket Questionnaire.[25]
Source: ITU.

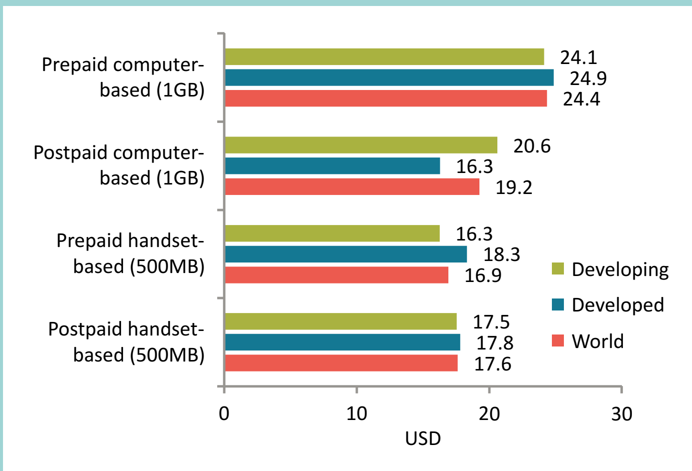
A feature of postpaid handset-based mobile-broadband plans is that they are in some cases bundled with voice minutes and SMS. This is particularly so in developed countries, where in one in four countries the cheapest postpaid handset-based Internet plans included free minutes and SMS in 2013. It is much less

Chart 4.12: Mobile-broadband prices, in PPP$, world and by level of development, 2013



Note: Simple averages. Based on 119 economies for which data on mobile-broadband prices were available for the four types of plans.
Source: ITU.

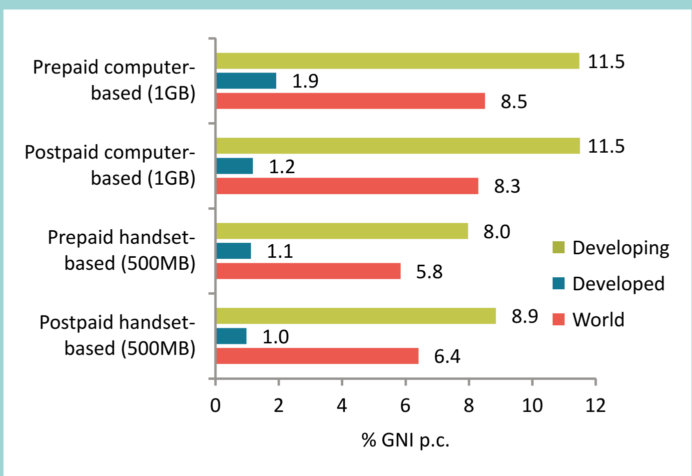
Chart 4.13: Mobile-broadband prices, in USD, world and by level of development, 2013



Note: Simple averages. Based on 119 economies for which data on mobile-broadband prices were available for the four types of plans.
Source: ITU.

common in developing countries, where fewer than one in ten countries have bundled offers as the cheapest option for postpaid handset-based mobile broadband. The existence of different levels of bundling in mobile-broadband plans makes it difficult to compare prices on a like-for-like basis.

Chart 4.14: Mobile-broadband prices as a percentage of GNI p.c., world and by level of development, 2013



Note: Simple averages. Based on 119 economies for which data on mobile-broadband prices were available for the four types of plans.
Source: ITU.

Mobile-broadband prices in PPP$ are more expensive in developing countries than in developed countries, for all types of plans. In terms of USD, mobile-broadband services cost almost the same on average in developed and developing countries (Chart 4.13). This suggests that operators in developing countries still have ample room to streamline their mobile-broadband services and offer cheaper prices. Indeed, operating costs should be lower in developing countries and, if enough competition exists in the market, these lower costs should be passed on to retail prices. This is the case, for instance, for fixed-telephone and mobile-cellular services.[26] The fact that this is not fully happening for fixed- and mobile-broadband services may be explained by the early stage of development of these services in the developing world. Operators are in the process of rolling out new infrastructure and most markets have not yet grown enough to allow operators to benefit from economies of scale and scope.

These differences in mobile-broadband prices between developed and developing countries are even more apparent when looking at the affordability of the service. Indeed, handset-based mobile-broadband plans with a monthly data allowance of 500 MB are about eight times more affordable in developed countries than in developing countries, on average (Chart 4.14). Computer-based services with a monthly allowance of 1 GB are about six times more affordable in developed countries, on average.

The regional analysis confirms that there are significant differences in the affordability of each service, and that there is a gap between Africa and the other regions (Chart 4.15). The average price for a computer-based mobile-broadband service with 1 GB monthly data allowance corresponded to more than 20 per cent of GNI p.c. in Africa, and around 15 per cent of GNI p.c. in the case of handset-based plans with 500 MB. Average prices represented less than 10 per cent of GNI p.c. in all other regions.

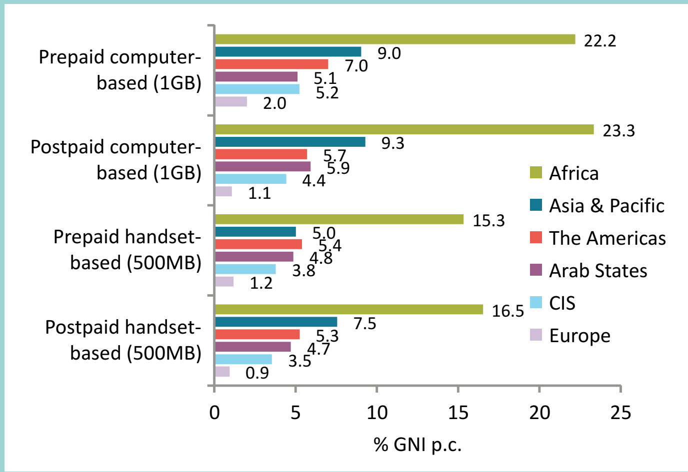
Mobile-broadband penetration in Africa is higher than might be expected given the high prices in the region, particularly when compared to the lower prices in other regions. Indeed, it is estimated that mobile-broadband penetration will reach 19 per cent in Africa by end 2014, as compared with 23 per cent in Asia and the Pacific and 25 per cent in the Arab States by the same date. This observation may be explained by different usage patterns in Africa, with mobile-broadband subscribers consuming much less than 500 MB of Internet data per month, supported by the fact that several African operators offer discount plans for occasional use. For instance, MTN Cameroon offers low-price mobile-broadband services priced per connection or per 15 minutes; Orange Côte d'Ivoire also offers discount plans priced per hour of use;[27] and almost all African operators offer low-volume bundles with a validity of one or two days. However, such low-volume short-validity plans allow only limited use of the Internet, and therefore restrict the benefits that can be obtained from broadband. For instance, Internet video cannot be consumed on the basis of such limited data allowances, and even Internet radio would need to be limited.

This suggests that, if mobile broadband is to bridge the broadband gap between Africa and the other regions, mobile-broadband services will have to become more affordable in Africa so that most applications enabled by a broadband connection are within the means of a majority of the population.

Europe stands out as having the most affordable mobile-broadband plans, corresponding to less than 2 per cent of GNI p.c. for all services. At the other end of the scale, Asia and the Pacific is, together with Africa, the region were average mobile-broadband prices correspond to significantly more than 5 per cent of GNI p.c. for all services except prepaid handset-based (500 MB).

In the Arab States and the CIS, handset-based mobile-broadband prices are on average below the 5 per cent threshold, and prices are just slightly above that value in the case of computer-

Chart 4.15: Mobile-broadband prices as a percentage of GNI p.c., by region, 2013

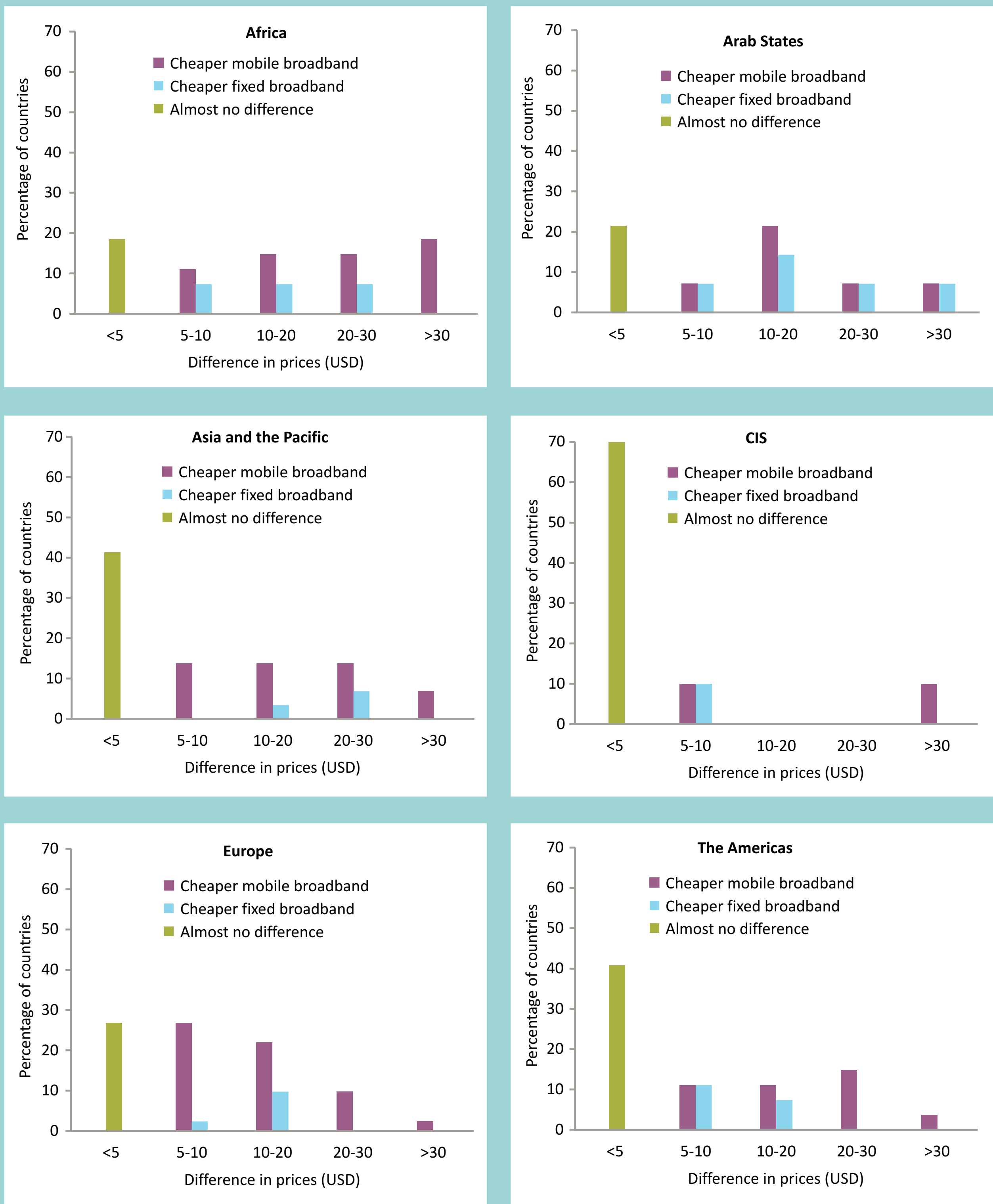


Note: Simple averages. Based on 119 economies for which data on mobile-broadband prices were available for the four types of plans.
Source: ITU.

based mobile-broadband services. The Americas region also has average prices corresponding to slightly more than 5 per cent of GNI p.c., prepaid computer-based plans being the only ones clearly above that threshold. Country data for the Americas reveal that there are a number of countries which have high prepaid computer-based prices because minimum packages include a monthly data allowance much larger than 1 GB (Table 4.8). This is the case of Chile (USD 73 for 14 GB), Antigua and Barbuda (USD 63 for 10 GB), Haiti (USD 23 for 10 GB), El Salvador (USD 28 for 8 GB) and Argentina (USD 46 for 7 GB). Such high monthly data allowances for prepaid mobile-broadband dongles suggest that these services target high-end customers, rather than the average user. Postpaid mobile-broadband dongles include much lower monthly data allowances in the Americas (Table 3.7), suggesting that postpaid rather than prepaid is the base offer for regular computer-based mobile-broadband customers.

Average prices for computer-based mobile-broadband plans with a monthly data allowance of 1 GB suggest that mobile broadband could be a cheaper alternative to fixed broadband in many

Chart 4.16: Comparison of postpaid fixed-broadband and postpaid computer-based mobile-broadband prices, in USD, by region, 2013



Note: Percentages are calculated on the basis of the total number of countries with data available in each region: 27 countries in Africa, 14 countries in the Arab States, 29 economies in Asia and the Pacific, 10 countries in the CIS, 41 countries in Europe and 27 countries in the Americas.

Source: ITU.

countries. There are qualitative differences that make mobile-broadband and fixed-broadband plans not strictly comparable (see Box 3.4 in ITU, 2013a). Nevertheless, mobile broadband may be the only alternative in countries where fixed wired infrastructure is underdeveloped or fixed-broadband services are unaffordable for a majority of the population.

Chart 4.16 shows a comparison of prices for fixed-broadband and postpaid computer-based mobile-broadband plans with a 1 GB monthly allowance. This latter mobile-broadband plan is chosen because it is the best match for fixed-broadband services: both are postpaid, are computer-based and include a monthly data allowance of at least 1 GB. Although the minimum data allowance is the same, in practice most fixed-broadband plans allow unlimited data use (Table 4.4), whereas most computer-based mobile-broadband plans with a minimum monthly data allowance of 1 GB really do have a cap of 1 GB (Tables 4.7 and 4.8).

In almost half of the African countries included in the price benchmark, mobile-broadband prices were more than USD 10 cheaper per month than fixed-broadband prices. Taking into account the GNI p.c. levels in Africa, such price savings could make the difference between a service being affordable or not. This is particularly so in Namibia, where an entry-level fixed-broadband plan corresponds to 10.6 per cent of GNI p.c., as against 3.2 of GNI p.c. for a computer-based mobile-broadband plan. In other African countries, mobile broadband may be a more affordable alternative to fixed broadband – for instance, in the Democratic Republic of the Congo and Zambia, where mobile broadband is more than USD 50 cheaper per month – but mobile-broadband prices still correspond to more than 5 per cent of GNI p.c. This reinforces the idea that mobile operators and policy-makers in Africa share the common challenge of achieving lower mobile-broadband prices in order to unlock the real potential of broadband in the region. More affordable prices could be a strong driver for uptake and therefore benefit both consumers and service providers.

In the Arab States and the CIS, there are almost as many countries where mobile broadband is cheaper than fixed broadband as vice versa. There are some exceptions, such as Tajikistan, where fixed-broadband prices are prohibitive (more than USD 100) and mobile-broadband prices are more in line with those of the region (USD 14.0 as against USD 9.3 on average in the region for 1 GB postpaid computer-based plans).

In many countries in Asia and the Pacific, there is little difference between fixed-broadband and mobile-broadband prices. Of those countries where mobile broadband is significantly cheaper, Indonesia and Thailand are the only ones in which the 5 per cent affordability target for broadband services is achieved, thanks to affordable mobile-broadband plans. In the Solomon Islands, Timor-Leste and Vanuatu, despite mobile broadband being more than USD 20 cheaper per month than entry-level fixed broadband, mobile-broadband prices are still high. This suggests that some of the bottlenecks in the fixed-broadband markets of SIDS in the Pacific, such as the lack of international Internet bandwidth, also constrain mobile-broadband services.

There are four countries in the Americas that attain the 5 per cent affordability target by virtue of cheaper mobile-broadband prices: Belize, El Salvador, Paraguay and Suriname. In these countries, mobile broadband is an affordable alternative to entry-level fixed-broadband plans. However, the mobile-broadband market is still in its early stages, with penetration rates below 5 per cent in Belize, El Salvador and Paraguay, and at 15 per cent in Suriname. Therefore, the extent to which Internet users turn to mobile broadband as an affordable alternative to fixed broadband will only be seen in the coming years.

Mobile broadband is cheaper than entry-level fixed–broadband plans in 80 per cent of countries in Europe, and in one out of three countries in

Table 4.5: Mobile-broadband prices, postpaid handset-based 500 MB, 2013

Rank	Economy	Mobile-broadband, postpaid handset-based (500 MB) as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
1	Austria	0.13	5.31	4.62	48'590	1'024
2	Finland	0.13	5.18	3.9	47'110	500
3	Iceland	0.13	4.83	4	43'930	500
4	Liechtenstein[1]	0.17	20.5	-	142'885	1'000
5	Denmark	0.17	8.9	5.92	61'110	1'024
6	Australia	0.18	9.65	6.49	65'520	500
7	Norway	0.2	16.85	10.1	102'610	1'024
8	Luxembourg	0.22	13.28	10.01	72'528	500
9	Qatar	0.23	16.48	22.4	85'550	1'000
10	Hong Kong, China	0.32	10.31	13.26	38'420	1'000
11	Lithuania	0.33	3.84	5.53	13'958	1'024
12	Poland	0.35	3.8	6.24	12'960	1'024
13	Russian Federation	0.41	4.68	8.16	13'860	500
14	Macao, China	0.41	22.28	30.15	64'691	500
15	Korea (Rep.)	0.47	10.05	12.02	25'920	500
16	Netherlands	0.5	19.92	16.8	47'440	500
17	Turkey	0.52	4.73	6.83	10'950	500
18	Belgium[2]	0.53	19.92	16.93	45'210	500
19	Sri Lanka	0.57	1.51	4.16	3'170	500
20	Spain[3]	0.59	14.46	14.17	29'180	500
21	Estonia	0.6	8.62	10.03	17'370	1'536
22	Sweden[4]	0.62	30.55	21.87	59'130	512
23	Slovenia	0.62	11.95	13.33	23'058	1'024
24	Switzerland	0.63	42.94	25.59	81'760	500
25	Slovakia	0.64	9.28	12.21	17'372	700
26	Belarus	0.66	3.72	9.9	6'720	500
27	Latvia	0.68	8.05	10.52	14'201	600
28	Kazakhstan	0.69	6.51	11.02	11'380	1'024
29	Greece	0.71	13.28	13.79	22'530	750
30	Singapore[5]	0.71	31.89	32.97	54'040	2'048
31	Kuwait	0.74	28.21	43.52	45'889	3'072
32	France[4]	0.75	26.42	22.51	42'250	3'000
33	United Kingdom	0.77	25.01	20.48	39'110	3'072
34	Croatia	0.77	8.59	11.65	13'330	1'024
35	Bahrain	0.81	13.3	22.67	19'756	500
36	Brunei Darussalam	0.81	22.38	33.72	33'002	2'048
37	United Arab Emirates	0.83	26.96	-	39'006	1'000
38	Azerbaijan	0.83	5.1	11.8	7'350	600
39	Tunisia	0.85	3.08	6.64	4'360	500
40	Portugal	0.85	14.61	15.78	20'670	500
41	Saudi Arabia	0.85	18.67	38.13	26'200	500
42	Hungary	0.86	8.94	13.92	12'534	500
43	Cyprus	0.9	19.92	21.47	26'654	1'024
44	Uruguay[6]	0.96	12.16	13.38	15'180	1'024
45	Germany[7]	0.97	37.12	33.98	46'100	500
46	Romania	1.06	7.97	12.88	9'060	500
47	New Zealand[8]	1.07	31.98	24.84	35'875	500
48	Montenegro	1.12	6.76	11.18	7'260	750
49	Panama	1.12	9.99	17	10'700	1'024
50	Canada	1.14	49.38	39.33	52'200	540
51	Japan	1.18	45.19	39.28	46'140	500
52	Czech Republic	1.18	17.83	23.49	18'060	1'024
53	Albania	1.21	4.73	8.67	4'700	500
54	Oman[9]	1.22	26.01	49.69	25'503	500
55	Bhutan	1.24	2.54	7.67	2'460	500
56	Suriname	1.28	9.85	16.69	9'260	500
57	Peru	1.39	7.4	12.39	6'390	500
58	Malaysia	1.39	12.06	23.91	10'400	500
59	Ireland[8]	1.41	46.47	36.57	39'501	500
60	Barbados	1.42	18	14.52	15'231	2'048
61	Bahamas	1.44	25	21.98	20'806	1'024
62	Mauritius	1.47	11.37	18.38	9'300	1'000
63	China	1.48	8.07	13.3	6'560	500
64	Armenia	1.55	4.88	10.39	3'790	1'500
65	Moldova	1.55	3.18	6.94	2'460	500
66	Italy[4]	1.57	45.14	40.63	34'400	1'124
67	TFYR Macedonia	1.61	6.44	12.84	4'800	1'024
68	Costa Rica[10]	1.63	13.01	17.81	9'550	500
69	Serbia	1.7	8.1	14.06	5'730	3'064
70	United States[11]	1.7	76.21	76.21	53'670	1'024
71	Indonesia	1.76	5.26	12.54	3'580	1'024
72	Mexico	1.88	15.58	21.22	9'940	500
73	Ukraine[12]	1.9	6.26	15.6	3'960	600
74	Venezuela	1.9	19.84	25.04	12'550	800
75	Bulgaria	1.97	11.53	22.14	7'030	500
76	Seychelles	1.99	20.73	29.34	12'530	500
77	Bosnia and Herzegovina	2.01	7.94	13.84	4'740	500
78	Georgia	2.02	6.01	12.48	3'570	500
79	Jordan	2.05	8.45	17.61	4'950	500

Table 4.5: Mobile-broadband prices, postpaid handset-based 500 MB, 2013 (continued)

		Mobile-broadband, postpaid handset-based (500 MB)				
Rank	Economy	as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
80	Maldives	2.08	9.7	12.6	5'600	700
81	Colombia	2.11	13.32	20.47	7'560	500
82	Trinidad & Tobago	2.12	27.82	34.91	15'760	5'000
83	Sudan	2.12	2	-	1'130	1'000
84	Pakistan	2.14	2.46	8.62	1'380	2'000
85	Gabon	2.28	20.24	27.95	10'650	500
86	Thailand	2.33	10.41	24.51	5'370	500
87	Iran (I.R.)	2.37	11.4	24.52	5'780	1'536
88	Antigua & Barbuda	2.38	25.56	31.09	12'910	500
89	Mongolia	2.51	7.87	16.77	3'770	1'024
90	Lebanon	2.51	20.64	-	9'870	750
91	South Africa	2.58	15.43	27.33	7'190	500
92	India	2.61	3.41	11.41	1'570	600
93	Chile[13]	2.65	33.58	42.05	15'230	600
94	Egypt	2.76	7.28	24.49	3'160	500
95	Malta[14]	2.8	46.47	54.28	19'927	1'024
96	Bolivia	3.34	7.09	15.79	2'550	500
97	Jamaica	3.44	14.96	20.98	5'220	3'072
98	Paraguay	3.45	11.62	21.06	4'040	1'024
99	Cambodia	3.47	2.75	7	950	500
100	Ecuador	3.66	16.79	29.43	5'510	500
101	Dominican Rep.	3.95	18.5	35.53	5'620	1'536
102	Brazil[15]	4.14	40.35	48.52	11'690	500
103	Lao P.D.R.	4.21	5.12	12.82	1'460	1'000
104	Philippines	4.31	11.76	25.77	3'270	1'000
105	El Salvador	4.52	14	26.65	3'720	1'024
106	Morocco	4.66	11.78	23.7	3'030	5'120
107	Botswana	5.54	35.72	-	7'730	500
108	Nigeria	5.6	12.88	21.39	2'760	750
109	Guatemala	5.72	15.91	30.86	3'340	1'024
110	Fiji	6.01	22.18	32.67	4'430	4'096
111	Timor-Leste	6.03	18	28.75	3'580	1'024
112	Cape Verde[16]	6.33	19.14	33.26	3'630	5'500
113	Samoa	6.81	19.47	23.89	3'430	500
114	Ghana	7	10.26	21.57	1'760	1'000
115	Nicaragua	7.36	10.92	26.63	1'780	1'024
116	Kenya	7.49	5.81	12.64	930	500
117	Swaziland	7.87	20.2	43.35	3'080	500
118	Nepal	7.92	4.82	15.19	730	500
119	Namibia	8.49	41.33	71.59	5'840	600
120	Kyrgyzstan	8.88	8.88	23.2	1'200	500
121	Afghanistan	10.78	6.29	17.67	700	500
122	Bangladesh	11.78	8.83	25.18	900	1'000
123	Lesotho	14.43	18.64	43.33	1'550	500
124	Zambia	15.78	19.46	38.07	1'480	500
125	Tanzania	16.07	8.44	19.08	630	500
126	Tajikistan	17.01	14.03	33.09	990	1'000
127	Mali	17.04	9.51	20.94	670	500
128	Uganda	18.18	7.73	18.19	510	500
129	Honduras	18.99	34.5	62.48	2'180	1'024
130	Angola	22.35	93.3	105.22	5'010	600
131	Côte d'Ivoire[17]	26.4	30.36	63.43	1'380	4'000
132	Burkina Faso	27.19	15.18	33.48	670	500
133	Zimbabwe	27.8	19	-	820	500
134	Mozambique	30.4	14.95	28.21	590	500
135	Solomon Islands	30.62	41.08	38.56	1'610	500
136	Madagascar	30.89	11.33	32.63	440	500
137	Haiti	34.13	23.04	44.46	810	7'168
138	Mauritania	37.73	33.32	-	1'060	500
139	S. Tomé & Principe	44.25	54.2	85.88	1'470	500
140	Congo (Dem. Rep.)	44.47	14.82	23.55	400	500
141	Benin	46.12	30.36	64.08	790	6'000
142	Vanuatu[18]	62.71	163.56	130.43	3'130	500
143	Niger	88.86	30.36	66.08	410	3'072
144	Gambia	335.14	142.43	-	510	500
	Andorra**	-	20.81	-	-	500
	Argentina**	-	14.47	-	-	500
	Monaco** [19]	-	45.14	-	-	1'024
	San Marino**	-	38.5	37.17	-	500
	Syria**	-	89.09	-	-	1'000

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.
Bundles include: 1) 60 minutes on-net, 300 SMS. 2) 120 mins, unlimited SMS. 3) 500 SMS. 4) Unlimited mins and SMS. 5) 100 outgoing mins, 800 local SMS/MMS. 6) 25 SMS. 7) Unlimited on-net mins, 100 off-net mins, unlimited SMS. 8) 300 mins, unlimited SMS. 9) 200 mins, 200 SMS/MMS. 10) 35 on-net mins, 400 on-net SMS. 11) Talk & Text. 12) 1 000 mins, 1 000 SMS, 1 000 MMS (on-net). 13) 100 mins, 100 SMS/MMS. 14) 2 000 on-net mins, 60 local mins, 2 000 on-net sms, 60 local SMS. 15) 60 mins. 16) 50 SMS. 17) 200 on-net SMS. 18) 720 mins. 19) 2h, unlimited SMS.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

Table 4.6: Mobile-broadband prices, prepaid handset-based 500 MB, 2013

Rank	Economy	Mobile-broadband, prepaid handset-based (500 MB) as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
1	Norway	0.1	8.34	5	102'610	500
2	Austria	0.13	5.31	4.62	48'590	1'024
3	Iceland	0.13	4.83	4	43'930	500
4	Sweden	0.15	7.52	5.38	59'130	1'024
5	Lithuania	0.2	2.31	3.32	13'958	1'024
6	Finland	0.23	9.03	6.79	47'110	500
7	Singapore	0.27	11.99	12.4	54'040	500
8	Qatar	0.31	21.98	29.87	85'550	3'000
9	Switzerland	0.33	22.66	13.5	81'760	500
10	Poland	0.35	3.8	6.24	12'960	1'024
11	Australia	0.35	19.31	12.99	65'520	700
12	Bahrain	0.4	6.65	11.34	19'756	500
13	Russian Federation	0.41	4.68	8.16	13'860	500
14	Kuwait	0.46	17.63	27.2	45'889	1'024
15	New Zealand	0.52	15.58	12.1	35'875	500
16	Estonia	0.58	8.43	9.81	17'370	500
17	Canada	0.63	27.43	21.85	52'200	500
18	Belarus	0.66	3.72	9.9	6'720	500
19	Kazakhstan	0.69	6.51	11.02	11'380	1'024
20	Italy[1]	0.69	19.78	17.81	34'400	1'024
21	Macao, China	0.7	37.55	50.81	64'691	800
22	United Kingdom	0.72	23.45	19.2	39'110	2'048
23	Brunei Darussalam	0.73	19.98	30.11	33'002	500
24	Slovakia	0.73	10.62	13.97	17'372	700
25	France	0.75	26.55	22.62	42'250	1'000
26	Uruguay	0.77	9.76	10.75	15'180	768
27	Croatia	0.79	8.73	11.84	13'330	500
28	Indonesia	0.8	2.39	5.7	3'580	600
29	Slovenia	0.83	15.93	17.77	23'058	500
30	United Arab Emirates	0.83	26.96	-	39'006	1'000
31	Azerbaijan	0.83	5.1	11.8	7'350	600
32	Tunisia	0.85	3.08	6.64	4'360	500
33	Portugal	0.85	14.61	15.78	20'670	500
34	Saudi Arabia	0.85	18.67	38.13	26'200	500
35	Hungary	0.86	8.94	13.92	12'534	500
36	Spain	0.86	20.87	20.45	29'180	500
37	Romania	0.88	6.64	10.73	9'060	500
38	Belgium[2]	0.88	33.19	28.21	45'210	500
39	Oman	0.92	19.51	37.27	25'503	500
40	Malta	0.96	15.93	18.61	19'927	1'200
41	Sri Lanka	0.98	2.6	7.16	3'170	1'024
42	Germany	1.03	39.63	36.28	46'100	600
43	Greece	1.06	19.92	20.68	22'530	600
44	Turkey	1.09	9.98	14.42	10'950	500
45	Costa Rica	1.1	8.79	12.03	9'550	500
46	Albania	1.21	4.73	8.67	4'700	500
47	Ireland[3]	1.21	39.83	31.34	39'501	500
48	Serbia	1.25	5.97	10.36	5'730	500
49	Pakistan	1.28	1.48	5.17	1'380	1'024
50	Hong Kong, China	1.32	42.29	54.37	38'420	5'000
51	Montenegro	1.34	8.1	13.4	7'260	600
52	Malaysia	1.39	12.06	23.91	10'400	1'024
53	Brazil	1.41	13.77	16.57	11'690	600
54	Barbados	1.46	18.5	14.92	15'231	2'048
55	United States[4]	1.46	65.33	65.33	53'670	2'048
56	Mauritius	1.47	11.37	18.38	9'300	1'000
57	Czech Republic	1.49	22.43	29.54	18'060	500
58	Moldova	1.55	3.18	6.94	2'460	500
59	Chile	1.59	20.17	25.26	15'230	800
60	TFYR Macedonia	1.61	6.44	12.84	4'800	1'024
61	Panama	1.68	14.99	25.51	10'700	1'024
62	Bahamas	1.73	30	26.38	20'806	1'024
63	Denmark	1.73	88.14	58.63	61'110	500
64	Trinidad & Tobago	1.76	23.15	29.06	15'760	2'000
65	Cyprus	1.81	40.19	43.34	26'654	600
66	Ukraine	1.9	6.26	15.6	3'960	600
67	Venezuela	1.9	19.84	25.04	12'550	800
68	Cape Verde	1.99	6.02	10.46	3'630	500
69	Netherlands	2.02	79.66	67.2	47'440	600
70	Georgia	2.02	6.01	12.48	3'570	500
71	Jordan	2.05	8.45	17.61	4'950	500
72	Seychelles	2.06	21.46	30.37	12'530	500
73	Maldives	2.08	9.7	12.6	5'600	700
74	Gabon	2.17	19.23	26.55	10'650	500
75	Bulgaria	2.31	13.5	25.94	7'030	512
76	Thailand	2.33	10.41	24.51	5'370	500
77	Iran (I.R.)	2.37	11.4	24.52	5'780	1'536
78	Mongolia	2.51	7.87	16.77	3'770	1'000
79	Lebanon	2.51	20.64	-	9'870	750

Table 4.6: Mobile-broadband prices, prepaid handset-based 500 MB, 2013 (continued)

Rank	Economy	Mobile-broadband, prepaid handset-based (500 MB) as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
80	Antigua & Barbuda	2.58	27.78	33.8	12'910	1'024
81	India	2.58	3.38	11.29	1'570	600
82	South Africa	2.75	16.47	29.16	7'190	500
83	Egypt	2.76	7.28	24.49	3'160	500
84	Peru	2.78	14.8	24.78	6'390	500
85	Mexico	2.83	23.41	31.89	9'940	1'024
86	Namibia	2.96	14.4	24.94	5'840	500
87	Turkmenistan	3.06	17.54	-	6'880	500
88	Colombia	3.31	20.87	32.06	7'560	2'048
89	Cambodia	3.47	2.75	7	950	500
90	Libya	3.49	39.3	-	13'508	500
91	Fiji	3.68	13.58	20	4'430	2'048
92	Iraq	3.76	21.01	-	6'710	500
93	Uzbekistan	3.79	6	-	1'900	500
94	Suriname	3.83	29.55	50.06	9'260	3'584
95	Armenia	3.86	12.21	25.97	3'790	500
96	Jamaica	4.01	17.46	24.47	5'220	3'072
97	Philippines	4.31	11.76	25.77	3'270	1'000
98	Guatemala	4.53	12.6	24.44	3'340	1'024
99	Sudan	4.66	4.39	-	1'130	2'000
100	Morocco	4.71	11.9	23.93	3'030	500
101	El Salvador	4.84	15	28.55	3'720	1'024
102	Bolivia	5.11	10.85	24.17	2'550	500
103	Ecuador	5.36	24.62	43.15	5'510	600
104	Paraguay	5.52	18.59	33.7	4'040	1'024
105	Ghana	5.6	8.21	17.26	1'760	500
106	Nigeria	5.6	12.88	21.39	2'760	750
107	Timor-Leste	6.03	18	28.75	3'580	1'024
108	Dominican Rep.	6.8	31.84	61.15	5'620	2'800
109	Samoa	6.81	19.47	23.89	3'430	540
110	Botswana	7.12	45.84	-	7'730	500
111	Kenya	7.49	5.81	12.64	930	500
112	Nepal	7.92	4.82	15.19	730	500
113	Honduras	8.1	14.72	27.86	2'180	1'024
114	Bosnia and Herzegovina	8.59	33.94	59.17	4'740	500
115	Kyrgyzstan	8.88	8.88	23.2	1'200	500
116	Swaziland	9.24	23.72	50.91	3'080	500
117	Bangladesh	9.82	7.36	20.98	900	800
118	Afghanistan	10.78	6.29	17.67	700	500
119	Nicaragua	10.89	16.15	39.38	1'780	2'048
120	Congo (Rep.)	11.41	25.3	39.66	2'660	500
121	Yemen	12.18	13.5	-	1'330	1'024
122	Vanuatu	14.63	38.17	30.43	3'130	512
123	Tanzania	14.88	7.81	17.67	630	500
124	Rwanda	15.07	7.79	18.94	620	500
125	Benin	15.37	10.12	21.36	790	500
126	Zambia	15.78	19.46	38.07	1'480	500
127	Tajikistan	17.01	14.03	33.09	990	1'000
128	Mali	17.04	9.51	20.94	670	500
129	Lesotho	17.64	22.79	52.96	1'550	600
130	Uganda	18.18	7.73	18.19	510	500
131	Angola	22.35	93.3	105.22	5'010	600
132	Sierra Leone	25.05	14.2	28.96	680	500
133	Côte d'Ivoire	26.4	30.36	63.43	1'380	4'000
134	Burkina Faso	27.19	15.18	33.48	670	500
135	Solomon Islands	28.07	37.66	35.34	1'610	500
136	Malawi	28.11	6.32	20.04	270	500
137	Papua New Guinea	29.26	49.01	-	2'010	500
138	Zimbabwe	29.27	20	-	820	500
139	Madagascar	31.51	11.55	33.28	440	500
140	Kiribati	33.16	72.4	-	2'620	500
141	Haiti	34.13	23.04	44.46	810	7'168
142	Mauritania	37.73	33.32	-	1'060	500
143	Mozambique	40.54	19.93	37.62	590	1'000
144	Congo (Dem. Rep.)	44.47	14.82	23.55	400	500
145	Chad	47.63	40.48	-	1'020	2'048
146	Senegal	56.75	50.6	103.01	1'070	5'120
147	Togo	68.74	30.36	64.05	530	500
148	Niger	88.86	30.36	66.08	410	3'072
149	Liberia	113.78	38.87	-	410	500
150	S. Tomé & Principe	138.27	169.38	268.39	1'470	500
	Andorra**	-	38.85	-	-	1'400
	Argentina**	-	9.16	-	-	500
	San Marino**	-	26.55	25.64	-	800

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.
Bundles include: 1) 200 mins, 200 SMS. 2) 150 mins, unlimited SMS. 3) Unlimited on-net mins and SMS, 100 international mins. 4) Unlimited on-net mins and SMS.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

Table 4.7: Mobile-broadband prices, postpaid computer-based 1 GB, 2013

Rank	Economy	Mobile-broadband, postpaid computer-based (1 GB) as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
1	Austria	0.13	5.31	4.62	48'590	1
2	Norway	0.20	16.85	10.10	102'610	1
3	Qatar	0.23	16.48	22.40	85'550	1
4	Iceland	0.24	8.92	7.38	43'930	1
5	Sweden	0.31	15.20	10.88	59'130	2
6	Hong Kong, China	0.32	10.31	13.26	38'420	1
7	Ireland	0.32	10.61	8.35	39'501	1
8	Finland	0.33	13.14	9.89	47'110	1
9	Denmark	0.35	17.63	11.73	61'110	1
10	Liechtenstein	0.35	42.08	-	142'885	5
11	United States	0.36	16.32	16.32	53'670	1
12	Italy	0.38	10.95	9.86	34'400	3
13	Lithuania	0.40	4.61	6.64	13'958	1
14	Luxembourg	0.44	26.55	20.02	72'528	5
15	Singapore	0.44	19.90	20.58	54'040	5
16	Australia	0.44	24.13	16.23	65'520	1
17	Switzerland	0.44	30.21	18.00	81'760	1
18	France	0.49	17.13	14.59	42'250	1
19	Poland	0.58	6.30	10.35	12'960	2
20	Romania	0.60	4.51	7.29	9'060	1
21	Oman	0.61	13.00	24.85	25'503	1
22	Germany	0.62	23.83	21.81	46'100	1
23	United Kingdom	0.62	20.32	16.64	39'110	1
24	Netherlands	0.67	26.55	22.40	47'440	1
25	Estonia	0.68	9.89	11.51	17'370	15
26	Kazakhstan	0.69	6.51	11.02	11'380	1
27	Macao, China	0.69	37.30	50.47	64'691	1
28	Belgium	0.70	26.54	22.56	45'210	2
29	Uruguay	0.76	9.67	10.64	15'180	1
30	Latvia	0.79	9.37	12.25	14'201	2
31	Malta	0.80	13.28	15.51	19'927	5
32	Brunei Darussalam	0.81	22.38	33.72	33'002	2
33	United Arab Emirates	0.83	26.96	-	39'006	1
34	Slovenia	0.83	16.03	17.88	23'058	3
35	Mauritius	0.84	6.51	10.53	9'300	2
36	Hungary	0.86	8.94	13.92	12'534	2
37	Cyprus	0.90	19.92	21.47	26'654	1
38	Belarus	0.92	5.14	13.68	6'720	2
39	Kuwait	0.92	35.26	54.40	45'889	15
40	Russian Federation	0.95	10.99	19.17	13'860	3
41	Canada	1.01	43.89	34.96	52'200	5
42	Libya	1.05	11.79	-	13'508	1
43	Greece	1.06	19.92	20.68	22'530	1
44	Croatia	1.10	12.27	16.64	13'330	2
45	Korea (Rep.)	1.12	24.11	28.85	25'920	2
46	Panama	1.12	9.99	17.00	10'700	1
47	Bahrain	1.13	18.62	31.74	19'756	5
48	Turkey	1.15	10.45	15.10	10'950	2
49	Bulgaria	1.15	6.72	12.90	7'030	1
50	Sri Lanka	1.15	3.04	8.38	3'170	6
51	Czech Republic	1.18	17.83	23.49	18'060	1
52	Portugal	1.19	20.51	22.16	20'670	1
53	Saudi Arabia	1.22	26.67	54.47	26'200	2
54	Egypt	1.27	3.35	11.27	3'160	1
55	Japan	1.32	50.57	43.96	46'140	3
56	Spain	1.32	32.13	31.48	29'180	1
57	New Zealand	1.37	40.96	31.82	35'875	2
58	Barbados	1.42	18.00	14.52	15'231	2
59	Azerbaijan	1.46	8.92	20.65	7'350	1
60	Chile	1.57	19.99	25.03	15'230	1
61	TFYR Macedonia	1.61	6.44	12.84	4'800	1
62	Slovakia	1.65	23.89	31.42	17'372	6
63	Serbia	1.70	8.10	14.06	5'730	3
64	Costa Rica	1.73	13.81	18.90	9'550	1
65	Malaysia	1.76	15.23	30.20	10'400	2
66	Indonesia	1.76	5.26	12.54	3'580	2
67	Venezuela	1.98	20.67	26.08	12'550	2
68	Trinidad & Tobago	2.12	27.82	34.91	15'760	5
69	Gabon	2.28	20.24	27.95	10'650	1
70	Mexico	2.35	19.50	26.56	9'940	1
71	Suriname	2.36	18.18	30.80	9'260	3
72	Bhutan	2.50	5.12	15.44	2'460	1
73	Mongolia	2.51	7.87	16.77	3'770	1
74	Colombia	2.54	16.00	24.58	7'560	1
75	Armenia	2.71	8.54	18.18	3'790	2

Table 4.7: Mobile-broadband prices, postpaid computer-based 1 GB, 2013 (continued)

Rank	Economy	Mobile-broadband, postpaid computer-based (1 GB) as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
76	Montenegro	2.89	17.49	28.93	7'260	3
77	China	2.95	16.14	26.60	6'560	2
78	Seychelles	2.98	31.10	44.01	12'530	1
79	Georgia	3.03	9.02	18.72	3'570	1
80	Thailand	3.11	13.90	32.71	5'370	1
81	Namibia	3.17	15.43	26.73	5'840	2
82	Brazil	3.23	31.49	37.87	11'690	2
83	Jordan	3.41	14.08	29.35	4'950	3
84	Maldives	3.49	16.27	21.14	5'600	3
85	Ukraine	3.49	11.51	28.69	3'960	1
86	Lebanon	3.83	31.50	-	9'870	2
87	Belize	3.86	15.00	25.80	4'660	1
88	Moldova	3.88	7.94	17.35	2'460	5
89	Dominican Rep.	3.95	18.50	35.53	5'620	2
90	Bosnia and Herzegovina	4.02	15.89	27.69	4'740	1
91	Peru	4.10	21.84	36.55	6'390	1
92	Albania	4.11	16.09	29.47	4'700	3
93	Paraguay	4.14	13.94	25.27	4'040	1
94	South Africa	4.30	25.79	45.67	7'190	1
95	El Salvador	4.51	13.99	26.63	3'720	2
96	Ecuador	4.63	21.28	37.30	5'510	1
97	Morocco	4.66	11.78	23.70	3'030	5
98	Lao P.D.R.	5.26	6.40	16.02	1'460	5
99	Antigua & Barbuda	5.47	58.89	71.65	12'910	10
100	Jamaica	5.73	24.94	34.96	5'220	1
101	Fiji	6.01	22.18	32.67	4'430	6
102	Cambodia	6.32	5.00	12.73	950	2
103	Cape Verde	6.33	19.14	33.26	3'630	6
104	Guatemala	6.63	18.46	35.80	3'340	1
105	Bolivia	6.74	14.33	31.91	2'550	2
106	Ghana	7.00	10.26	21.57	1'760	1
107	Timor-Leste	8.38	25.00	39.92	3'580	2
108	Philippines	8.60	23.44	51.38	3'270	2
109	Botswana	9.24	59.53	-	7'730	2
110	Nicaragua	9.30	13.80	31.99	1'780	1
111	Nigeria	9.80	22.54	37.44	2'760	2
112	Kyrgyzstan	10.12	10.12	26.43	1'200	1
113	Samoa	11.36	32.46	39.81	3'430	1
114	Bangladesh	11.78	8.83	25.18	900	1
115	Pakistan	12.26	14.10	49.43	1'380	30
116	India	12.39	16.21	54.19	1'570	6
117	Nepal	13.87	8.44	26.61	730	1
118	Honduras	13.93	25.30	45.82	2'180	5
119	Kenya	14.98	11.61	25.28	930	2
120	Sudan	15.16	14.27	-	1'130	5
121	Tajikistan	17.01	14.03	33.09	990	1
122	Zambia	18.78	23.17	45.32	1'480	1
123	Equatorial Guinea	20.35	242.90	-	14'320	1
124	Tanzania	20.47	10.75	24.31	630	1
125	Lesotho	20.85	26.93	62.59	1'550	1
126	Afghanistan	21.56	12.58	35.35	700	1
127	Côte d'Ivoire	26.40	30.36	63.43	1'380	4
128	Mali	27.19	15.18	33.41	670	1
129	Vanuatu	29.26	76.33	60.87	3'130	2
130	Uganda	34.09	14.49	34.11	510	1
131	Haiti	34.13	23.04	44.46	810	10
132	Burkina Faso	36.25	20.24	44.65	670	5
133	Mauritania	37.73	33.32	-	1'060	1
134	Mozambique	40.54	19.93	37.62	590	1
135	Ethiopia	41.35	16.20	43.05	470	1
136	Benin	46.12	30.36	64.08	790	6
137	Guinea	56.20	21.54	-	460	3
138	Madagascar	56.85	20.84	60.04	440	1
139	Solomon Islands	57.49	77.13	72.39	1'610	1
140	Congo (Dem. Rep.)	59.30	19.77	31.40	400	1
141	Zimbabwe	65.85	45.00	-	820	1
142	Togo	72.23	31.90	67.29	530	2
143	Burundi	137.80	32.15	83.41	280	1
144	Gambia	164.28	69.82	-	510	1
	Andorra**	-	38.85	-	-	2
	Argentina**	-	20.15	-	-	1
	Monaco**	-	58.95	-	-	7
	San Marino**	-	38.50	37.17	-	1
	Syria**	-	89.09	-	-	1

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

Table 4.8: Mobile-broadband prices, prepaid computer-based 1 GB, 2013

		Mobile-broadband, prepaid computer-based (1 GB)				
Rank	Economy	as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
1	Austria	0.13	5.31	4.62	48'590	1
2	Liechtenstein	0.18	21.58	-	142'885	1
3	Finland	0.23	9.03	6.79	47'110	1
4	Italy	0.38	10.95	9.86	34'400	3
5	Qatar	0.39	27.47	37.34	85'550	6
6	Iceland	0.44	16.29	13.48	43'930	5
7	Kuwait	0.46	17.63	27.20	45'889	1
8	Bahrain	0.48	7.98	13.60	19'756	2
9	United States	0.49	21.78	21.78	53'670	1
10	Brunei Darussalam	0.58	15.99	24.09	33'002	1
11	Belgium	0.59	22.31	18.96	45'210	1
12	Ireland	0.61	19.92	15.67	39'501	1
13	Oman	0.61	13.00	24.85	25'503	1
14	Switzerland	0.62	42.08	25.07	81'760	2
15	Netherlands	0.67	26.55	22.40	47'440	1
16	Kazakhstan	0.69	6.51	11.02	11'380	1
17	Slovenia	0.69	13.28	14.81	23'058	1
18	Australia	0.71	38.62	25.97	65'520	1
19	France	0.75	26.55	22.62	42'250	2
20	New Zealand	0.82	24.60	19.11	35'875	1
21	United Arab Emirates	0.83	26.96	-	39'006	1
22	Belarus	0.92	5.14	13.68	6'720	2
23	Estonia	0.92	13.28	15.45	17'370	15
24	Russian Federation	0.95	10.99	19.17	13'860	3
25	Sri Lanka	0.98	2.60	7.16	3'170	1
26	Germany	1.03	39.70	36.34	46'100	1
27	Sweden	1.04	51.07	36.56	59'130	6
28	Slovakia	1.05	15.24	20.05	17'372	1
29	Croatia	1.10	12.27	16.64	13'330	1
30	Egypt	1.11	2.91	9.80	3'160	1
31	Portugal	1.16	19.92	21.51	20'670	1
32	Uruguay	1.16	14.65	16.12	15'180	1
33	Spain	1.19	28.84	28.25	29'180	1
34	Saudi Arabia	1.22	26.67	54.47	26'200	2
35	Hong Kong, China	1.32	42.29	54.37	38'420	5
36	Albania	1.33	5.20	9.54	4'700	1
37	Macao, China	1.39	75.10	101.62	64'691	2
38	Azerbaijan	1.46	8.92	20.65	7'350	1
39	Mauritius	1.47	11.37	18.38	9'300	1
40	Romania	1.58	11.95	19.32	9'060	6
41	Malta	1.60	26.55	31.02	19'927	17
42	Indonesia	1.60	4.78	11.40	3'580	1.2
43	TFYR Macedonia	1.61	6.44	12.84	4'800	1
44	Turkey	1.67	15.23	22.01	10'950	1
45	Panama	1.68	14.99	25.51	10'700	1
46	Hungary	1.73	18.11	28.20	12'534	3
47	Serbia	1.75	8.36	14.50	5'730	1
48	Malaysia	1.76	15.23	30.20	10'400	2
49	Trinidad & Tobago	1.76	23.15	29.06	15'760	2
50	Brazil	1.99	19.41	23.35	11'690	2
51	Jordan	2.05	8.45	17.61	4'950	2
52	Greece	2.12	39.83	41.37	22'530	5
53	Cape Verde	2.35	7.10	12.34	3'630	1
54	United Kingdom	2.40	78.17	63.99	39'110	2
55	Mongolia	2.51	7.87	16.77	3'770	1
56	Tunisia	2.54	9.23	19.93	4'360	5
57	Bhutan	2.62	5.37	16.18	2'460	1
58	Cyprus	2.69	59.75	64.42	26'654	1
59	Maldives	2.79	13.02	16.91	5'600	2
60	Czech Republic	2.79	42.00	55.32	18'060	1
61	Mexico	2.83	23.41	31.89	9'940	1
62	Seychelles	2.98	31.10	44.01	12'530	1
63	Georgia	3.03	9.02	18.72	3'570	1
64	Colombia	3.31	20.87	32.06	7'560	2
65	Thailand	3.45	15.43	36.31	5'370	1
66	Bulgaria	3.46	20.29	38.97	7'030	1
67	Ukraine	3.49	11.51	28.69	3'960	1
68	Montenegro	3.51	21.23	35.12	7'260	5
69	Lebanon	3.83	31.50	-	9'870	2
70	Belize	3.86	15.00	25.80	4'660	1
71	Moldova	3.88	7.94	17.35	2'460	1.666
72	Fiji	4.27	15.75	23.20	4'430	2
73	Philippines	4.31	11.76	25.77	3'270	1
74	Gabon	4.33	38.46	53.10	10'650	1
75	Morocco	4.71	11.90	23.93	3'030	1

Table 4.8: Mobile-broadband prices, prepaid computer-based 1 GB, 2013 (continued)

		Mobile-broadband, prepaid computer-based (1 GB)				
Rank	Economy	as % of GNI p.c.	USD	PPP$	GNI p.c., USD, 2013*	Monthly data allowance (MB)
76	South Africa	4.82	28.90	51.17	7'190	1
77	Suriname	4.91	37.88	64.17	9'260	5
78	Namibia	5.09	24.75	42.88	5'840	1
79	Paraguay	5.52	18.59	33.70	4'040	1
80	Lithuania	5.59	65.00	93.50	13'958	280
81	Uzbekistan	5.68	8.99	-	1'900	1
82	Chile	5.72	72.65	90.98	15'230	14
83	Antigua & Barbuda	5.82	62.59	76.15	12'910	10
84	Cambodia	6.32	5.00	12.73	950	2
85	Angola	6.70	27.99	31.57	5'010	1
86	Guatemala	6.81	18.96	36.79	3'340	2
87	Jamaica	6.88	29.93	41.96	5'220	1
88	Ghana	7.00	10.26	21.57	1'760	1
89	Dominican Rep.	7.04	32.96	63.30	5'620	3
90	Iraq	7.52	42.02	-	6'710	1
91	Sudan	7.88	7.42	-	1'130	3
92	Honduras	8.10	14.72	27.86	2'180	1
93	Peru	8.20	43.67	73.10	6'390	2
94	Timor-Leste	8.38	25.00	39.92	3'580	2
95	El Salvador	9.03	28.00	53.30	3'720	8
96	Nigeria	9.80	22.54	37.44	2'760	2
97	Kyrgyzstan	10.12	10.12	26.43	1'200	1
98	Bolivia	10.22	21.71	48.35	2'550	2
99	Pakistan	10.22	11.76	41.23	1'380	5
100	Ecuador	10.72	49.24	86.30	5'510	1
101	Armenia	10.82	34.18	72.71	3'790	28
102	Nicaragua	10.89	16.15	39.38	1'780	1
103	Botswana	11.09	71.44	-	7'730	1
104	Yemen	12.18	13.50	-	1'330	1
105	Samoa	12.95	37.01	45.40	3'430	1
106	Nepal	13.87	8.44	26.61	730	1
107	Kenya	14.98	11.61	25.28	930	2
108	Bangladesh	15.71	11.78	33.57	900	2
109	Swaziland	16.10	41.33	88.69	3'080	2
110	Tajikistan	17.01	14.03	33.09	990	1
111	Bosnia and Herzegovina	17.60	69.52	121.17	4'740	1
112	Tanzania	17.85	9.37	21.20	630	1
113	Zambia	18.78	23.17	45.32	1'480	1
114	Cameroon	19.13	20.24	42.84	1'270	2
115	Iran (I.R.)	20.18	97.21	208.98	5'780	4
116	Congo (Rep.)	21.00	46.55	72.97	2'660	1
117	Afghanistan	21.56	12.58	35.35	700	1
118	Rwanda	24.11	12.46	30.30	620	1
119	Côte d'Ivoire	26.40	30.36	63.43	1'380	4
120	Lesotho	26.46	34.18	79.44	1'550	1
121	Vanuatu	27.17	70.88	56.52	3'130	2
122	Mali	27.19	15.18	33.41	670	1
123	Benin	30.75	20.24	42.72	790	3
124	Uganda	34.09	14.49	34.11	510	1
125	Haiti	34.13	23.04	44.46	810	10
126	Burkina Faso	36.25	20.24	44.65	670	5
127	Mauritania	37.73	33.32	-	1'060	1
128	Mozambique	40.54	19.93	37.62	590	1
129	Sierra Leone	41.75	23.66	48.26	680	1
130	Zimbabwe	51.22	35.00	-	820	1
131	Madagascar	55.61	20.39	58.74	440	1
132	Solomon Islands	56.14	75.32	70.69	1'610	1
133	Guinea	56.20	21.54	46.84	460	3
134	Malawi	56.21	12.65	40.08	270	1
135	Senegal	56.75	50.60	103.01	1'070	5
136	Congo (Dem. Rep.)	59.30	19.77	31.40	400	1
137	Togo	72.23	31.90	67.29	530	2
138	Niger	88.86	30.36	66.08	410	3
139	Liberia	117.07	40.00	-	410	1
140	Chad	133.35	113.35	-	1'020	4
141	Gambia	164.28	69.82	-	510	1
142	Burundi	282.21	65.85	170.82	280	1
	Andorra**	-	38.85	-	-	1
	Argentina**	-	46.16	-	-	7
	Nauru**	-	43.44	-	-	5

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates. ** Country not ranked because data on GNI p.c. are not available for the last five years.

Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

the region mobile broadband is more than USD 10 cheaper per month. This is a striking finding, taking into account that Europe is the region with the most affordable fixed-broadband plans. This reflects the early launch of 3G services in Europe[28] and the maturity achieved in the mobile-broadband market, with a mobile-broadband penetration of 57 per cent by end 2013, the highest of all regions. European countries dominate the global top ten of most affordable mobile-broadband plans, with Austria, Finland and Iceland featuring in the top ten for all categories of mobile-broadband services (Tables 4.5 to 4.8).

4.4 Income inequality and broadband prices

The affordability of ICT services depends as much on the price of the service itself as on the economic means of the specific customer. In this and previous *Measuring the Information Society* Reports, affordability has been measured in terms of prices as a percentage of GNI per capita, thus showing how much ICT services cost relative to the economic value generated by each country. However, overall economic levels, as measured by macroeconomic variables such as GNI, do not reflect the actual means of the population nor how income is distributed. In order to understand better the affordability of ICT services, other variables such as household disposable income need to be considered.

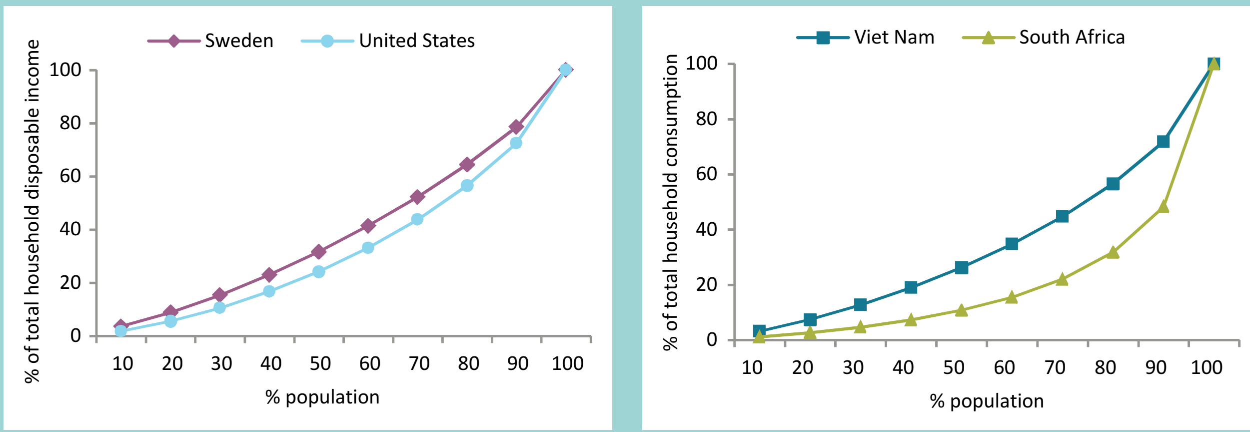
Measurement efforts related to tracking the global development goals on poverty – such as Millennium Development Goal 1: Eradicate extreme poverty and hunger – have contributed to making available more data on household and individual economic welfare, as well as its distribution. This section presents a refined analysis of the affordability of broadband services for a number of countries for which data on the distribution of household income or consumption expenditure are available. The objective is to explore how factors such as income inequality may affect people's access to, and use of, broadband services.

Household disposable income and GNI are two fundamentally different economic indicators. On the one hand, GNI is a macroeconomic aggregate similar to gross domestic product (GDP) and measures the size of a country's economy as a whole, including the business sector. It is a measure of the value of the national production of an economy, and is calculated in the context of national accounts. It is similar to GDP, except that GNI accounts for primary flows in and out of the country.[29] GNI has been used as a measure of national economic development and, in view of its wide availability, as a way of classifying countries by income levels – for instance by the World Bank.[30]

Data on household income, on the other hand, measure only people's economic welfare, and do not include the business sector. Household disposable income is a measure of all the income received by the members of a household[31] less the taxes and social security contributions paid directly by the household. Data are collected by national statistical offices by means of household income and expenditure surveys (HIES) or household surveys including a module on income/expenditure – such as some national implementations of the Living Standards Measurement survey or the European Union survey on Income and Living Conditions – and processed to produce a breakdown of disposable income by quantiles. The household is taken as the unit within which income sources are pooled and equally shared. This implies that the income of the household is attributed to each of its members, irrespective of who in the household receives that income.[32] In order to classify income data by deciles, individuals are placed in ascending order according to the household income attributed to them, and then the population is divided into ten equal parts, each corresponding to an income decile.[33]

An alternative measure to household disposable income is household consumption expenditure,

Chart 4.17: Distribution of household disposable income (left) and household consumption (right), selected countries, 2011 or latest available year



Source: Data for the United States and Sweden are sourced from the OECD Database on Income Distribution and refer to 2011. Data for South Africa and Viet Nam are sourced from the World Bank's PovcalNet and refer to 2008.

which is often considered a better indicator for living standards. This is particularly the case for developing countries, where income may be difficult to measure – because of large informal sectors and self-employment – and other barriers to consumption expenditure, such as access and availability of products, may be relevant.[34] Data on household consumption expenditure are also obtained from household surveys.

Caution must be exercised when making international comparisons based on data on household economic welfare, because there are several methodological issues that limit comparability, notably: differing household survey vehicles and periodicity, the choice of income or consumption as the reference for household economic means, and differing equivalence scales.[35] Nevertheless, household-level economic data provide information (not available from macroeconomic indicators) on the actual income and expenditure capacity of households in a country and the differences across households. Subject to the caveats previously mentioned, these data can be used to obtain a finer-grain indication of the affordability of broadband services for households from different economic levels.

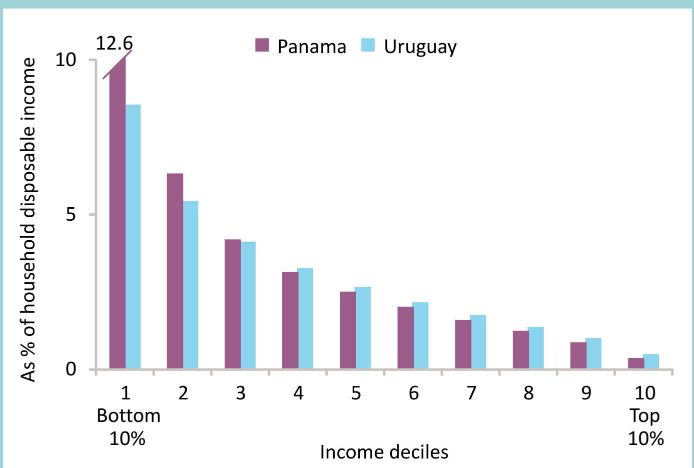
Chart 4.17 shows the household income and expenditure distribution in four selected countries from the developed and the developing world. In Sweden, the poorest 20 per cent of the population have 9 per cent of total household disposable income, compared with 5 per cent in the United States. Differences increase when comparing the top income deciles: the richest 20 per cent hold 34 per cent of total household income in Sweden, as against 44 per cent in the United States. Disparities in the distribution of economic welfare also occur in the developing world, in some cases even to a larger extent. The richest 20 per cent concentrate 43 per cent of total household consumption in Viet Nam, and as much as 68 per cent in South Africa. This is a remarkable difference given that the distribution of income is typically more unequal than the distribution of consumption, and therefore differences in income distribution would probably be even larger. These examples show that income and consumption distribution can vary significantly across developing as well as developed countries.

Fixed broadband

Income inequality also has an impact on the affordability of broadband prices. For example, taking two countries that have similar fixed-broadband prices in terms of GNI p.c., Chart 4.18 uses data on income inequality to reveal differences in the affordability of fixed-broadband services between these two countries, and even larger differences within each country. In Chart 4.18, the affordability of a fixed-broadband plan for the first decile is calculated by dividing the price of the fixed-broadband plan by the average disposable income of the poorest 10 per cent of the population in the country. Conversely, for the tenth decile, the price of the fixed-broadband plan is divided by the disposable income of the richest 10 per cent of the population in the country. It is assumed that the cost of the fixed-broadband subscription is shared by all members of the household, and therefore the price of the plan is divided by the estimated income of all members of a household.[36]

In Panama, the poorest 10 per cent of the population would need to spend 12.6 per cent of their household disposable income to subscribe to an entry-level fixed-broadband plan, whereas the richest 10 per cent of the population would only be spending 0.3 per cent of their household income. In Uruguay, for a similar fixed-broadband plan, the poorest 10 per cent of the population would need to spend 8.5 per cent of their household disposable income, whereas the outlay would represent only 0.5 per cent of household disposable income for the richest 10 per cent of the population. The comparison between the two countries shows that fixed broadband is more affordable for low-income households in Uruguay than in Panama. This is explained by income distribution: low-income households in Uruguay have a higher share of total household income than in Panama. Conversely, for middle and high-income households in Panama, entry-level fixed broadband is slightly more affordable than for the corresponding households in Uruguay. This example illustrates how income inequalities may explain differences in the affordability of fixed-broadband services within a country, and between countries with similar fixed-broadband prices expressed as a percentage of GNI p.c.

Chart 4.18: Fixed-broadband prices as a percentage of household disposable income, by income deciles, Panama and Uruguay, 2013



Source: ITU. Household disposable income based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

In addition to highlighting differences in fixed-broadband affordability due to income inequality within countries, economic data at the household level also make it possible to determine more precisely the affordability of residential fixed-broadband services. As an example, Chart 4.19 shows that the price of an entry-level fixed-broadband plan corresponds to a larger share of household consumption expenditure in Angola than in Uganda for all deciles, despite the fact that prices in terms of GNI p.c. are almost three times lower in Angola.[37] The richest 10 per cent of the population in Uganda would need to devote 4.2 per cent of their household expenditure to subscribe to a fixed-broadband plan, compared with 6.7 per cent in the case of the richest 10 per cent of the population in Angola. Affordability is clearly a barrier to fixed-broadband adoption in Angola: for 60 per cent of the population in the country, the price of a basic fixed-broadband plan corresponds to more than a quarter of their household expenditure. In Uganda, fixed broadband is less expensive, but still unaffordable for many: for the poorest 40 per cent of the population in the country it would represent more than a quarter of their total household expenditure.

Table 4.9 and Table 4.10 show the price of entry-level fixed-broadband plans as a percentage of household disposable income and household consumption expenditure, respectively. It is assumed that all members of the household share the cost of the fixed-broadband subscription, and therefore prices are divided by the estimated household income or consumption expenditure.

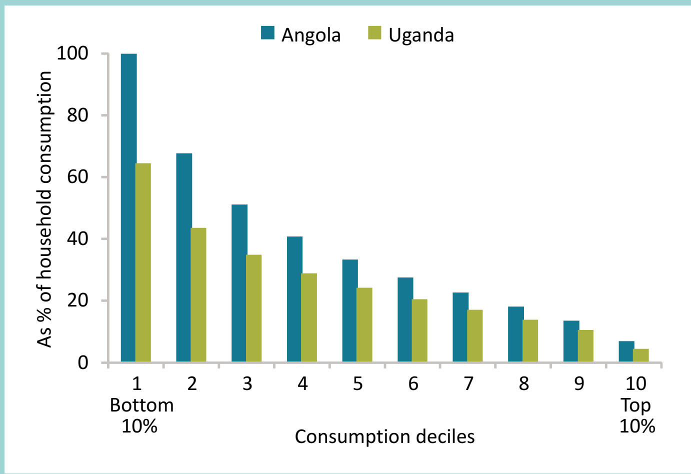
Taking as a reference the affordability threshold set by the Broadband Commission (i.e. an entry-level broadband service should be made affordable … "amounting to less than 5% of average monthly income") and applying this threshold to both household disposable income and expenditure data, the following conclusions can be drawn:

- In more than 85 per cent of countries for which data are available, the richest 20 per cent of the population can afford an entry-level fixed-broadband plan. The remaining 15 per cent of countries are from Sub-Saharan Africa, all of them LDCs except for Nigeria and Swaziland. In most of these countries, the cost of a basic fixed-broadband plan corresponds to more than 20 per cent of household expenditure for 80 per cent of the population (less in Togo and Angola: 60 and 70 per cent, respectively). Making fixed broadband more affordable should thus be a priority for ICT policy-makers and regulators in these countries, since cost constitutes a major barrier for almost the entire population.

- In 40 per cent of countries for which data are available, a basic fixed-broadband subscription still represents more than 5 per cent of household income/consumption for over half of the population. This is the case not only in low-income countries, but also in several countries classified as upper-middle-income economies by the World Bank: several Latin American countries (Colombia, Dominican Republic, Ecuador and Peru), two African countries (Angola and South Africa) and Belarus, Serbia and Thailand. These countries should also address the issue of affordability of fixed-broadband services among low and middle-income households, since price may still be a barrier for many households.

- Income and expenditure inequalities within countries greatly influence the affordability of fixed broadband. The smallest differences are in Iceland, where an entry-level fixed-broadband plan is 3.5 times more affordable for the richest 20 per cent of the population than for the poorest 20 per cent. Differences are much wider in several developing countries, such as Brazil, Colombia, Honduras, Bolivia and South Africa, where fixed broadband is more than 20 times more affordable for the richest 20 per cent of the population than for the poorest 20 per cent. As a result, in most developing countries for which data on household income or expenditure distribution are available, fixed-broadband plans remain

Chart 4.19: Fixed-broadband prices as a percentage of household consumption, by consumption deciles, Angola and Uganda, 2013



Source: ITU. Household consumption based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

Table 4.9: Fixed-broadband prices as a percentage of household disposable income, selected countries, 2013

Country	Fixed-broadband prices as a % of household disposable income			% households whee fixed broadband < 5% household income
	Average	Lowest 20%*	Highest 20%*	
Ireland	0.37	0.97	0.18	100
United Kingdom	0.39	1.06	0.19	100
Switzerland	0.45	1.07	0.23	100
Luxembourg	0.53	1.14	0.29	100
Japan	0.54	1.66	0.27	100
Austria	0.57	1.24	0.32	100
France	0.65	1.52	0.33	100
United States	0.68	2.47	0.31	100
Norway	0.69	1.49	0.41	100
Finland	0.71	1.50	0.40	100
Italy	0.76	2.16	0.39	100
Iceland	0.80	1.62	0.47	100
Belgium	0.81	1.79	0.46	100
Australia	0.82	2.29	0.41	100
Netherlands	0.83	1.88	0.44	100
Sweden	0.83	1.89	0.47	100
Canada	0.84	2.25	0.42	100
Greece	0.88	2.61	0.43	100
Denmark	0.88	1.83	0.51	100
Slovenia	0.92	1.96	0.54	100
Korea (Rep.)	1.03	3.10	0.54	100
Poland	1.05	2.64	0.54	100
Germany	1.06	2.43	0.56	100
Portugal	1.27	3.46	0.60	100
Czech Republic	1.29	2.62	0.72	100
New Zealand	1.35	3.48	0.68	100
Slovakia	1.96	4.26	1.11	100
Russian Federation	0.59	1.94	0.26	90
Israel	1.04	3.81	0.49	90
Spain	1.06	3.49	0.53	90
Estonia	1.67	4.55	0.85	90
Turkey	1.25	4.41	0.53	80
Panama	1.39	8.41	0.49	80
Brazil	1.53	10.76	0.52	80
Uruguay	1.63	6.63	0.64	80
Malaysia	1.64	7.22	0.64	80
Mexico	1.70	8.42	0.66	80
Hungary	3.23	7.13	1.76	80
Costa Rica	1.94	10.08	0.69	70
Chile	2.23	10.31	0.79	70
Colombia	2.89	19.28	0.96	50
Peru	3.03	15.52	1.15	50
Ecuador	3.06	14.25	1.14	50
El Salvador	3.57	19.24	1.34	50
Honduras	3.51	34.76	1.17	40
Paraguay	3.73	22.86	1.32	40
Dominican Rep.	4.94	21.16	1.87	30
Bolivia	7.20	67.58	2.43	20

Note: Data on household disposable income refer to 2011 or latest year available. * 'Lowest 20%' refers to the price divided by the average income of the first and second income/consumption deciles. 'Highest 20%' refers to the price divided by the average income of the ninth and tenth income/consumption deciles.

Source: ITU. Household disposable income for OECD countries and the Russian Federation based on data from the OECD Database on Income Distribution adjusted with ITU estimates on average persons per household. Household disposable income and consumption expenditure for other countries based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

Table 4.10: Fixed-broadband prices as a percentage of household consumption expenditure, selected countries, 2013

Country	Fixed-broadband prices as a % of household consumption expenditure			% households where fixed broadband < 5% expenditure
	Average	Lowest 20%*	Highest 20%*	
Croatia	1.60	3.98	0.76	100
Lithuania	1.76	5.31	0.79	90
Tunisia	1.99	5.90	0.93	90
Jordan	2.10	5.44	0.96	90
Viet Nam	2.42	6.52	1.11	80
Romania	2.69	6.08	1.49	80
Montenegro	2.74	6.27	1.47	80
TFYR Macedonia	2.40	8.89	0.96	70
Fiji	2.67	8.60	1.08	70
Azerbaijan	2.95	7.39	1.40	70
Sri Lanka	2.98	7.72	1.34	70
Albania	3.03	7.45	1.41	70
Bhutan	3.23	9.58	1.41	60
Latvia	3.53	10.11	1.68	60
Kazakhstan	3.93	8.62	2.05	60
Ukraine	3.76	12.88	1.48	40
Egypt	4.65	10.07	2.31	40
Sudan	4.84	14.21	2.28	40
South Africa	3.40	25.18	1.00	30
Thailand	5.19	15.36	2.23	30
Georgia	5.35	21.27	2.25	30
Bangladesh	5.44	12.25	2.63	30
Armenia	5.57	12.63	2.75	30
Serbia	5.77	13.80	3.02	30
Moldova	5.98	15.32	2.90	30
Nepal	6.14	14.84	2.96	20
Belarus	6.65	14.16	3.71	20
Cambodia	6.87	17.32	3.09	20
Philippines	7.92	26.49	3.19	20
Côte d'Ivoire	8.11	28.97	3.41	10
Lao P.D.R.	8.39	21.95	3.74	10
Kyrgyzstan	9.07	23.62	4.38	10
Senegal	9.25	30.59	3.95	10
Mauritania	9.43	31.33	4.01	10
Uganda	15.11	51.74	5.96	10
Togo	19.36	64.66	8.47	0
Angola	21.73	80.47	8.93	0
Burkina Faso	24.26	72.20	10.31	0
Mali	27.86	69.92	13.49	0
Swaziland	29.34	144.91	10.37	0
Nigeria	35.06	119.04	15.21	0
Ethiopia	44.45	111.69	21.24	0
Zambia	68.76	384.13	22.12	0
Madagascar	123.19	455.40	49.14	0
Malawi	160.18	568.03	63.87	0
Central African Rep.	439.65	2609.18	145.10	0
Rwanda	490.31	1900.41	172.52	0

Note: Data on household consumption expenditure refer to 2011 or latest year available. * 'Lowest 20%' refers to the price divided by the average expenditure of the first and second consumption expenditure deciles. 'Highest 20%' refers to the price divided by the average expenditure of the ninth and tenth consumption expenditure deciles.

Source: ITU. Household consumption expenditure based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

unaffordable for large segments of the population.

Looking at the six regions, the following points can be highlighted:

- In most European countries, entry-level fixed-broadband prices represent less than 5 per cent of household income/expenditure for almost all households.[38] The main exception is Serbia, where a basic fixed-broadband plan corresponds to more than 5 per cent of consumption expenditure for 70 per cent of households in the country.

- In CIS countries, affordability varies from very affordable in the Russian Federation to rather unaffordable in Belarus and Kyrgyzstan, where more than three quarters of households would need to spend more than 5 per cent of their household consumption expenditure to subscribe to an entry-level fixed-broadband plan.

- In the Americas, basic fixed-broadband plans are affordable for around 80 per cent of the population in Brazil, Mexico, Panama and Uruguay, whereas in Bolivia and the Dominican Republic their cost would correspond to more than 5 per cent of household income for 70 per cent of the population. In the other Latin American countries, fixed broadband is unaffordable for many: a basic subscription would correspond to more than 5 per cent of household income for 40 per cent of the population or more. In contrast, in the United States and Canada, entry-level fixed broadband plans are affordable for almost all households.

- There is also a wide range in Asia and the Pacific: while entry-level prices are affordable for almost all households in high-income economies in the region, in Cambodia, Nepal and the Philippines fixed-broadband prices represent more than 5 per cent of consumption expenditure for most households. Viet Nam and Sri Lanka stand out because, despite low income levels, the cost of an entry-level fixed-broadband plan represents less than 5 per cent of household expenditure for 70 per cent of the population.

- In the Arab States, the comparison is limited by lack of data on the distribution of household income/expenditure. Available data suggest that basic fixed-broadband plans are affordable for 90 per cent of the population in Jordan and Tunisia, whereas they are less affordable in Egypt and Sudan, where their cost would correspond to more than 5 per cent of household consumption expenditure for most of the population. Indeed, in Egypt and Sudan, income inequalities explain why the cost of a basic fixed-broadband plan represents less than 2.5 per cent of household consumption expenditure for the richest 20 per cent of the population, as against more than 10 per cent of household expenditure for the poorest 20 per cent of the population.

Mobile broadband

The same approach is used to analyse how income inequalities within countries determine the affordability of mobile-broadband services.

Table 4.11 and Table 4.12 show the price of prepaid handset-based mobile-broadband plans (with a 500 MB monthly data allowance) as a percentage of disposable household income and household consumption expenditure, respectively. Prepaid handset-based mobile-broadband prices are chosen for the comparison because prepaid handset-based is on average the cheapest of the four mobile-broadband services for which ITU collects price data (Chart 4.13), and is currently the mobile-broadband service that is available in most countries (Chart 4.11).

Handset-based mobile-broadband services are affordable for the large majority of the population in all developed countries except Ukraine, where the cost of the service represents more than 5 per cent of household expenditure for more than half of the population. The unaffordability of prepaid handset-based mobile-broadband plans in Ukraine is partially attributable to income and expenditure inequalities: for the richest 20 per cent of the population, the cost of the service corresponds to 1.5 per cent of their household expenditure (thus affordable), whereas for the poorest 20 per cent of the population it represents 12.9 per cent of household expenditure (making it quite unaffordable). Ukraine is the developed country with the lowest mobile-broadband penetration, which suggests that the unaffordability of handset-based mobile-broadband services for low- and middle-income households is holding back mobile-broadband adoption in the country.

The affordability of prepaid handset-based mobile-broadband services differs considerably across developing countries and within some developing countries because of income inequalities. In Latin American, for example, the cost of handset-based mobile-broadband services in countries such as Ecuador, El Salvador, Honduras and Paraguay corresponds to less than 1.5 per cent of household disposable income for the richest 20 per cent of the population, but more than 15 per cent of household disposable income for the poorest 20 per cent of the population. Other developing countries that are in a similar situation because of household income and expenditure inequalities include Sudan, Philippines and Nepal.

In Africa, handset-based mobile-broadband prices are affordable (i.e. represent less than 5 per cent of household expenditure) for less than 40 per cent of the population in every country for which data are available. This is also the situation in Armenia, Dominican Republic and Egypt. In these countries, a prepaid handset-based mobile-broadband plan represents, on average, more than 5 per cent of household income or expenditure, suggesting that mobile-broadband affordability is an issue irrespective of income/expenditure distribution.

On the other hand, in developing countries such as Azerbaijan, Cambodia, Chile, Costa Rica, Jordan, Uruguay, Tunisia and Turkey, handset-based mobile-broadband services are affordable for almost the entire population. This suggests that neither handset-based mobile-broadband prices nor income/expenditure inequalities are a barrier to mobile-broadband adoption in these countries.

A comparison of fixed-broadband and prepaid handset-based mobile-broadband prices shows that mobile broadband may be the only affordable alternative for low-income households in several developing countries. For instance, for more than 40 per cent of the population in Belarus, Cambodia, Georgia, Moldova, Serbia and Thailand, a handset-based mobile-broadband plan corresponds to less than 5 per cent of household expenditure, whereas a basic fixed-broadband plan represents more than that. As a result, mobile broadband may contribute significantly to making broadband available to low-income households in these countries. In other developing countries where fixed-broadband services are affordable for most of the population, mobile broadband may help to connect the 20-30 per cent of households with the lowest incomes for which a fixed-broadband plan may be unaffordable, but which could afford a mobile-broadband plan. This might be the case in countries such as Albania, Azerbaijan, Kazakhstan, Sri Lanka and TFYR Macedonia.

This assessment of the impact of income inequalities on the affordability of mobile-broadband services is made on the basis of the cost of one handset-based mobile-broadband subscription per household. However, subscription data show that, in developed countries, handset-based mobile-broadband subscriptions are individual, rather than shared per household. In some countries, such as for instance Australia, Denmark, Finland and

Table 4.11: Prepaid handset-based mobile-broadband (500 MB/month) prices as a percentage of household disposable income, selected countries, 2013

Country	Prepaid handset-based mobile-broadband prices as a % of household disposable income			% population for which prepaid handset-based mobile broadband < 5% household income
	Average	Lowest 20%*	Highest 20%*	
Norway	0.11	0.24	0.07	100
Austria	0.12	0.26	0.07	100
Iceland	0.12	0.25	0.07	100
Sweden	0.16	0.37	0.09	100
Finland	0.21	0.45	0.12	100
Switzerland	0.28	0.66	0.15	100
Australia	0.30	0.83	0.15	100
Poland	0.32	0.81	0.17	100
New Zealand	0.34	0.88	0.17	100
Russian Federation	0.44	1.45	0.19	100
Canada	0.50	1.35	0.26	100
Italy	0.56	1.59	0.29	100
Slovenia	0.58	1.24	0.34	100
United Kingdom	0.59	1.59	0.28	100
France	0.62	1.44	0.32	100
Estonia	0.66	1.81	0.34	100
Portugal	0.67	1.81	0.32	100
Spain	0.69	2.28	0.35	100
Ireland	0.74	1.95	0.36	100
Greece	0.75	2.23	0.37	100
Belgium	0.81	1.80	0.46	100
Hungary	1.02	2.25	0.56	100
Germany	1.06	2.42	0.56	100
United States	1.36	4.94	0.62	100
Czech Republic	1.40	2.84	0.79	100
Slovakia	1.57	3.10	0.87	100
Denmark	1.66	3.42	0.96	100
Costa Rica	1.07	5.57	0.38	90
Uruguay	1.13	4.60	0.44	90
Chile	1.18	5.42	0.42	90
Turkey	1.55	5.62	0.68	90
Netherlands	1.87	4.25	0.99	90
Malaysia	0.94	4.16	0.37	80
Brazil	1.53	10.72	0.52	80
Panama	1.95	11.79	0.69	70
Peru	2.04	10.42	0.77	70
Mexico	3.01	14.89	1.17	60
Colombia	3.05	20.32	1.01	50
Bolivia	3.12	29.30	1.05	50
Paraguay	3.27	20.05	1.16	50
El Salvador	3.39	18.26	1.28	50
Honduras	3.44	34.11	1.15	40
Ecuador	3.73	17.40	1.39	40
Dominican Rep.	7.39	31.66	2.80	20

Note: Data on household disposable income refer to 2011 or latest year available. * 'Lowest 20%' refers to the price divided by the average income of the first and second income deciles. 'Highest 20%' refers to the price divided by the average income of the ninth and tenth income deciles.

Source: ITU. Household disposable income for OECD countries and the Russian Federation based on data from the OECD Database on Income Distribution adjusted with ITU estimates on average persons per household. Household disposable income for other countries based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

Table 4.12: Prepaid handset-based mobile-broadband (500 MB/month) prices as a percentage of household consumption expenditure, selected countries, 2013

Country	Prepaid handset-based mobile-broadband prices as a % of household consumption expenditure			% population for which prepaid handset-based mobile broadband < 5% household expenditure
	Average	Lowest 20%*	Highest 20%*	
Lithuania	0.35	1.07	0.16	100
Croatia	0.79	1.95	0.37	100
Jordan	0.94	2.43	0.43	100
Tunisia	1.00	2.98	0.47	100
Montenegro	1.18	2.69	0.63	100
Azerbaijan	1.18	2.96	0.56	100
Albania	1.26	3.11	0.59	100
Moldova	1.49	3.83	0.73	100
Cambodia	1.57	3.97	0.71	100
TFYR Macedonia	1.20	4.44	0.48	90
Sri Lanka	1.78	4.62	0.80	90
Serbia	1.89	4.53	0.99	90
Kazakhstan	2.02	4.42	1.05	90
Romania	2.05	4.63	1.13	90
Fiji	1.90	6.14	0.77	80
Thailand	2.41	7.12	1.03	80
Belarus	2.80	5.96	1.56	80
Georgia	2.67	10.64	1.12	70
Sudan	3.72	10.93	1.76	60
Ukraine	3.76	12.88	1.48	40
Philippines	3.96	13.23	1.59	40
Nepal	4.66	11.26	2.25	40
South Africa	3.28	24.26	0.96	30
Egypt	5.17	11.19	2.56	30
Mali	5.55	13.92	2.69	30
Armenia	6.19	14.03	3.06	20
Côte d'Ivoire	6.76	24.14	2.84	20
Kyrgyzstan	6.77	17.63	3.27	20
Burkina Faso	8.27	24.61	3.52	10
Uganda	8.54	29.23	3.37	10
Bangladesh	9.06	20.41	4.38	10
Nigeria	11.13	37.79	4.83	10
Rwanda	11.50	44.58	4.05	10
Swaziland	12.22	60.34	4.32	10
Senegal	12.85	42.49	5.49	10
Togo	13.03	43.50	5.70	10
Mauritania	15.04	49.96	6.40	10
Zambia	18.05	100.83	5.81	10
Malawi	18.66	66.18	7.44	0
Madagascar	24.35	90.02	9.71	0
Angola	39.94	147.92	16.42	0

Note: Data on household consumption expenditure refer to 2011 or latest year available. * 'Lowest 20%' refers to the price divided by the average expenditure of the first and second expenditure deciles. 'Highest 20%' refers to the price divided by the average expenditure of the ninth and tenth expenditure deciles.

Source: ITU. Household consumption expenditure based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

Sweden, there is on average more than one mobile-broadband subscription per person. The situation is more diverse in the developing world. On the one hand, there are many more mobile-broadband subscriptions than households in countries such as Botswana, Bahrain, Costa Rica, Qatar and the United Arab Emirates, suggesting that handset-based mobile-broadband subscriptions are also individual in these countries. On the other hand, there are fewer mobile-broadband subscriptions than households in most African countries and in several developing countries in the Asia and the Pacific and Americas regions. This is consistent with the early stages of development of the mobile-broadband market in these countries, but it may also indicate that handset-based mobile-broadband subscriptions are shared per household. In addition, fixed-broadband infrastructure may have a limited reach in several developing countries, where mobile broadband may thus be the only alternative for household access.

In order to take into consideration both situations (i.e. individual and shared use of handset-based mobile broadband), Chart 4.20 complements the previous analysis by showing the affordability of handset-based mobile-broadband plans assuming that each member of the household has his/her own SIM card with a mobile-broadband plan. In this case, affordability is measured in terms of equivalized income or consumption per person.[39]

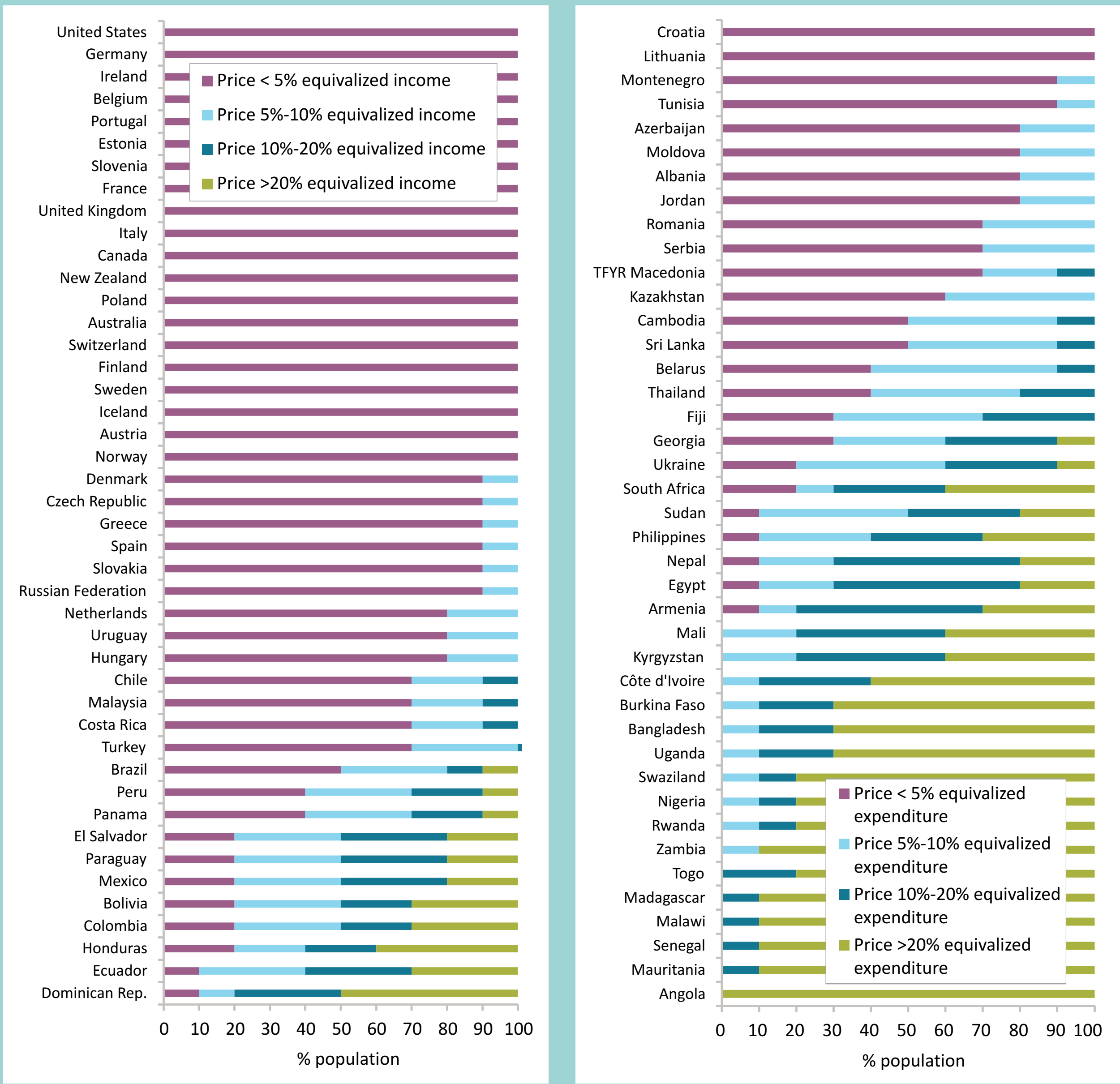
Data show that handset-based mobile-broadband prices (with a 500 MB monthly allowance) are affordable for a majority of the population in developed countries, but much less so in developing countries. This suggests that a large proportion of households in the developing world could not afford to have one handset-based mobile-broadband plan per person, and would have to share a subscription among members of the household.

Handset-based mobile-broadband prices are affordable for almost all households in Europe,[40] and so most of them could afford to have one handset-based mobile-broadband subscription per person. This is consistent with the high mobile-broadband penetration in Europe. In the CIS region, individual handset-based mobile-broadband plans are also affordable for most of the population in the Russian Federation, Azerbaijan, Moldova and Kazakhstan. On the other hand, the cost of a handset-based mobile-broadband plan represents more than 10 per cent of the equivalized household expenditure for 80 per cent of the population in Kyrgyzstan and Armenia. This may explain why these countries have the lowest mobile-broadband penetration in the CIS, along with Georgia. Income inequalities within countries partly explain these results: in Armenia, the richest 10 per cent of the population could afford to pay for one mobile-broadband plan with 500 MB/month for each person in the household; the next 10 per cent richest (ninth decile) could afford to have a shared mobile-broadband plan with 500 MB/month in the household; for the remaining 80 per cent of the population, such a mobile-broadband plan would be somewhat unaffordable (i.e. represent more than 5 per cent of household consumption expenditure).

In Latin America, individual handset-based mobile-broadband subscriptions are affordable for almost the whole population in Uruguay, Chile and Costa Rica. These are the only countries in Latin America, together with Brazil, with mobile-broadband penetrations above 30 per cent. In Brazil, Peru and Panama, an individual handset-based mobile-broadband subscription remains unaffordable for around 20 to 30 per cent of the population. In the other Latin American countries included in the comparison, affordability would be an issue for half of the population, for which the cost of a 500 MB handset-based mobile-broadband plan would represent more than 10 per cent of equivalized household income.

In Asia and the Pacific, the affordability of individual handset-based mobile-broadband subscriptions ranges from very affordable in

Chart 4.20: Prepaid handset-based mobile-broadband prices (500 MB/month) as a percentage of equivalized household income (left), and equivalized household consumption expenditure (right), by deciles, 2013



Note: Data on equivalized household income and consumption expenditure per decile refer 2011 or latest available year.
Source: ITU. Equivalized household disposable income for OECD countries and the Russian Federation based on data from the OECD Database on Income Distribution. Equivalized household disposable income and consumption for other countries based on World Bank's PovcalNet data adjusted with ITU estimates on average persons per household.

high-income economies (Australia and New Zealand) to unaffordable for a majority of the population in Bangladesh, Nepal and the Philippines. This tallies with the variations in mobile-broadband penetration in the region, which ranges from more than 100 per cent in Australia to less than 1 per cent in Bangladesh. Cambodia and Sri Lanka stand out for having lower penetrations than would be expected given the affordability of handset-based mobile-broadband services: although they represent less than 5 per cent of the equivalized household expenditure for half of the inhabitants in the country, who could thus afford to have one subscription per household member, mobile-broadband penetration remains below 10 per cent. Considering the high mobile-cellular penetration in both countries, this suggests they are in a good position to see an increase in mobile-broadband adoption in the coming years.

Data for the Arab States are limited to four countries. In Tunisia and Jordan, individual handset-based mobile-broadband subscriptions are affordable for a majority of the population. Nevertheless, income inequalities in these two countries mean that individual mobile-broadband plans would be somewhat unaffordable (i.e. represent more than 5 per cent of household expenditure) for the poorest 20 per cent of the population, who may thus need to share a mobile-broadband plan with other members of their household. In Egypt and Sudan, the cost of a mobile-broadband plan corresponds to more than 10 per cent of equivalized household expenditure for more than half of the population. Taking into consideration that these two countries had mobile-broadband penetrations of around 30 per cent by end 2013, mobile-broadband uptake could be held back if income inequalities persist.

Africa is the region where a prepaid handset-based mobile-broadband plan with a 500 MB monthly allowance is the least affordable in the light of household expenditure. In South Africa, the African country where prices are most affordable, they still correspond to more than 10 per cent of equivalized household expenditure for 70 per cent of inhabitants. This means that only the richest 30 per cent of the population could afford to have a handset-based mobile-broadband subscription for each member of the household, whereas the remaining 70 per cent of the population could not afford to have an individual subscription. For the other African countries included in the comparison, prices are unaffordable for a higher proportion of the population, suggesting that in almost all households handset-based mobile-broadband subscriptions would need to be shared. This is consistent with mobile-broadband penetrations in these countries, which were all below 30 per cent by end 2013. It highlights that low household income and expenditure constitute major barriers for increasing mobile-broadband adoption in many African countries.

On the basis of the data presented, it can be concluded that income inequality does not only have an impact on the proportion of households within a country that have access to mobile-broadband services, but in some cases also determines whether individuals can afford their own subscription or have to share a subscription within the household. In some developing countries, the richest households may have the means to pay for individual handset-based mobile-broadband subscriptions, while the rest may share the subscription with other members of the household. As a result, affordability may also explain different patterns of use of mobile-broadband services across developing countries, and income inequality similar differences within countries. Thus, mobile-broadband usage patterns may not only be determined by cultural and user preferences, but also by affordability.

4.5 The impact of competition and regulation on telecommunication prices

The impact of ICTs as development enablers depends on access to ICT services and the use that is made of them (see Figure 2.1). In turn, both access to and use of ICTs are determined to a large extent by the affordability of ICT services. Therefore, the ultimate goal of policy and regulatory interventions in the sector is often to bring about a sustainable reduction in the prices of ICT services, and in many cases this is achieved through regulatory actions to promote competition, such as mandating local-loop unbundling or granting a licence to a new entrant in the mobile-cellular market. This section presents a quantitative analysis of the role of competition and regulation in shaping prices for mobile-cellular (voice and SMS) and fixed-broadband services. Among all ICT services, mobile cellular and fixed broadband have been selected for the analysis because of the availability of comprehensive data series on the prices for these two services, which makes it possible to study the impact of different factors on prices across countries and time.

There is an extensive body of literature looking at the effects of competition and regulation on ICT adoption.[41] However, research is more limited when it comes to analysing the impact of competition and regulation on prices, and is often limited in scope because of lack of data for developing countries. Quantitative studies are in several cases restricted to samples of EU and OECD countries, or else to subregional and country case studies. This section aims to contribute to closing the gap in terms of quantitative analysis in order to support evidence-based policy-making in developing countries, by using ITU price and regulatory data for up to 144 countries in the period 2008-2013. Including such a large set of countries in the sample, most of them from the developing world, makes it possible to formulate some genuine global conclusions on the links between competition, regulation and telecommunication prices, based on a worldwide representative sample, and to check to what extent the quantitative results based on telecommunication data from EU, OECD and specific countries hold true in a global context. On the other hand, extending the number of countries included in the analysis has the trade-off of restricting the length of the time series and the level of detail of the indicators, since data availability and comparability for such a large number of countries is more limited. Therefore, more specific quantitative results, such as the impact of a specific regulatory intervention on telecommunication prices (e.g. mandating infrastructure sharing or granting a new licence), lie beyond the scope of this analysis.

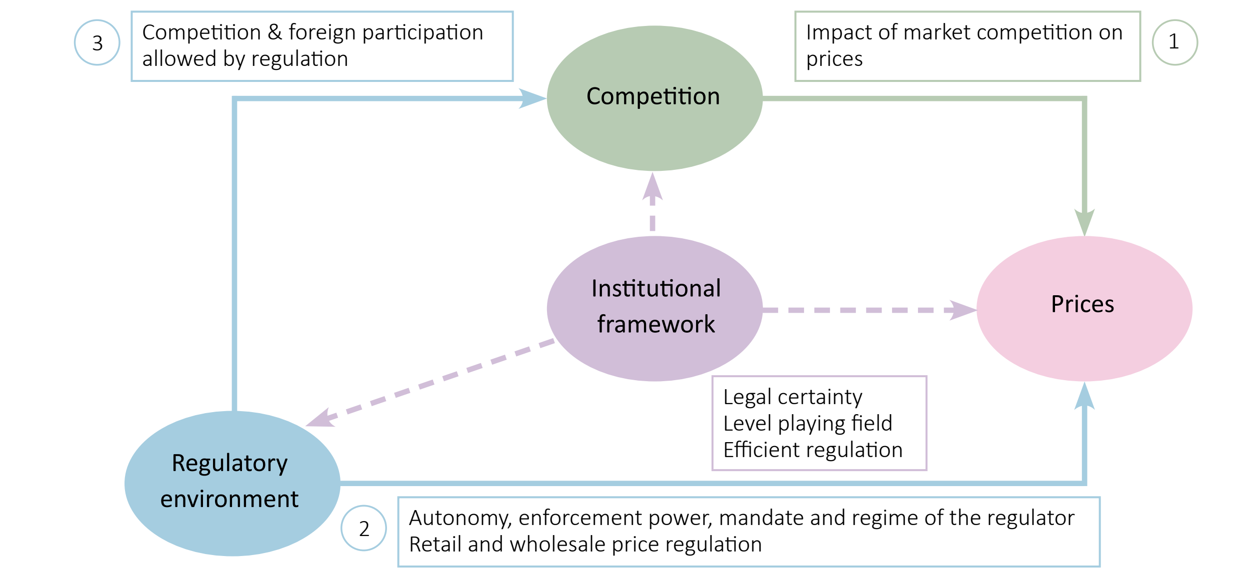
Overview of the links between regulation, competition and prices

The fall in telecommunication prices in the last decade, and in the period analysed in this chapter (2008-2013), is linked to several factors, including technological progress and standardization, which have made more efficient network infrastructure available at lower cost.[42] A pivotal element for ensuring that lower costs are passed on in terms of lower prices for customers is competition. In recent decades, there has been a global trend towards the liberalization of telecommunication services and the privatization of incumbent operators. In parallel, national regulators have been created to establish a level playing field and monitor the liberalized electronic communication markets (ITU, 2013b). Regulators have thus become the custodians of competition in telecommunication services at the country level.

From the literature on cross-national institutional analysis, there is a broad consensus on the importance of institutional soundness and its links to the performance of capital-intensive industries like telecommunications.[43] A country's institutional endowment determines the scope for arbitrary administrative discretion, the legal certainty necessary for investors and, through this, the performance of regulated industries.[44] Various industry performance indicators have been reported to correlate with improved regulatory governance, including prices and adoption levels.[45]

These findings help shape the conceptual framework for the econometric models presented in this section (Figure 4.2). Competition directly affects prices in markets where retail prices are deregulated, such as the majority of mobile-cellular and fixed-broadband markets. Regulatory and policy action can also have a direct impact on retail prices, as is the case with some entry-level fixed-broadband plans in Brazil and Uruguay that have been created as part of the broadband strategies implemented in these countries.[46] Regulators can also intervene

Figure 4.2: Relationship between regulation, competition and prices



Source: ITU.

indirectly on retail prices through wholesale price regulation, such as for instance by regulating mobile termination rates, as happens in most countries.[47]

Regulation also affects the level of competition in each market, for instance by dictating the number of licences issued in mobile-cellular markets or by limiting foreign participation in fixed-line operators. In addition, regulation is a significant part of the institutional framework that affects telecommunication markets. Thus, it can contribute to creating legal certainty and a level playing field, which are important drivers for investment and competition. In addition, regulation can promote efficiency, e.g. infrastructure and spectrum efficiency, which may help to drive prices down.

For the purpose of the analysis carried out in this section, the impact of the regulatory environment on prices is measured as the combination of the effects of the regulator's autonomy, enforcement power, mandate and regime (i.e. 2 in Figure 4.2). The direct impact of regulation on competition (i.e. 3 in Figure 4.2) is not considered, as it cannot be separated from the effects of competition on prices (i.e. 1 in Figure 4.2), which are accounted for by the variables on competition.

Market competition is one of the main drivers of affordable prices in telecommunication services. Chart 4.21 shows the evolution of average entry-level fixed-broadband prices and competition. The latter is measured using the Herfindahl-Hirschman Index (HHI) for the fixed-broadband market. The HHI is a measure of market concentration, and is calculated as the sum of the squared market shares (in terms of number of subscriptions) of each Internet service provider (ISP). The result ranges from 0 (perfect competition) to 1 (no competition, with only one operator in the market). The fall in entry-level fixed-broadband prices coincides with an increase in competition in the period 2008-2013. Chart 4.22 shows the evolution of entry-level prices and competition in mobile-cellular markets, where the decline in prices during the period 2008-2013 has also coincided with an increase in competition.

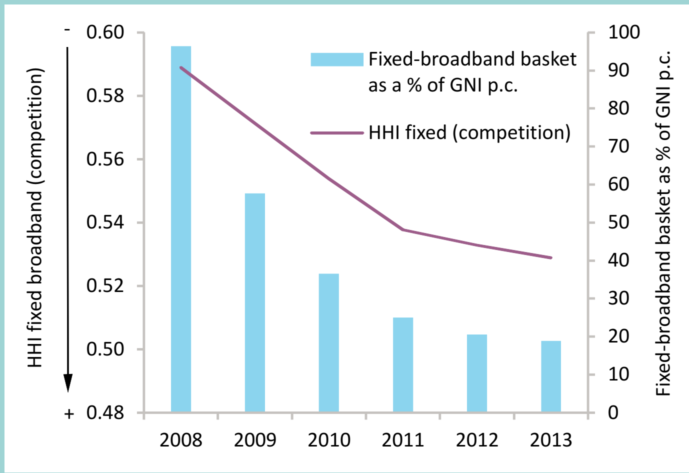
These simple descriptive statistics do not necessarily mean, however, that there is a causal relationship between competition and prices, because there are other factors apart from competition that may also have contributed to improving the affordability of fixed-broadband and mobile-cellular prices in the period 2008-2013. For instance, economic development may have increased incomes, and thus made services more affordable even if prices have been kept constant. Other factors, such as demographic changes, migrations or exchange-rate fluctuations, may also have had an impact on the affordability of fixed-broadband and mobile-cellular services. In order to take into account all these factors, the following section presents an econometric model based on panel data regression. This enables us to go beyond descriptive statistics and draw some robust conclusions on the link between competition and prices.

The model is also applied to measure the link between regulation and the prices of mobile-cellular and fixed-broadband services. The regulatory environment in each country is assessed based on the ITU ICT Regulatory Tracker (hereinafter the 'Regulatory Tracker').[48] The Regulatory Tracker includes 50 indicators divided into four different clusters, each one quantifying a specific aspect of the regulatory environment:

- Cluster 1: the independence, decision and enforcement powers, autonomy and accountability of the **regulatory authority**;
- Cluster 2: the **regulatory mandate** in the different segments of the telecommunication sector;
- Cluster 3: the **regulatory regime** in the different areas covered by the regulatory authority, which quantifies the areas that are regulated and how;
- Cluster 4: the com**petition framework** set by the laws and regulations that defines the level of competition in the different markets (based on what is legally permissible), and the measures to protect competition and the openness of the market to private and foreign investment.

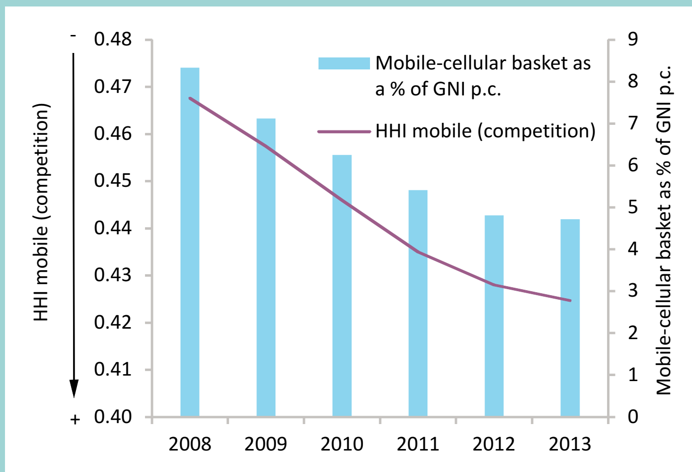
The scores of each cluster are combined into a single value for the Regulatory Tracker. The higher

Chart 4.21: Competition in fixed-broadband markets and fixed-broadband prices as a percentage of GNI p.c., 2008-2013



Note: Simple averages for 140 economies with available data on fixed-broadband prices and competition for the period 2008-2013.
Source: ITU. Herfindahl-Hirschman Index (HHI) data sourced from Informa.

Chart 4.22: Competition in mobile markets and mobile-cellular prices as a percentage of GNI p.c., 2008-2013



Note: Simple averages for 140 economies with available data on mobile-cellular prices and competition for the period 2008-2013.
Source: ITU. Herfindahl-Hirschman Index (HHI) data sourced from Informa.

Figure 4.3: Composition of the variable measuring the regulatory environment

Regulatory authority

1. Separate telecom/ICT regulator
2. Autonomy in decision making
3. Accountability
4. Percentage of diversified funding
5. Public consultations mandatory before decisions
6. Enforcement power
7. Sanctions or penalties imposed by regulator
8. Dispute resolution mechanism
9. Appeals to decisions
10. Existence of competition authority

CLUSTER 1

+

Regulatory mandate

Entity in charge of:

1. QoS measures and monitoring
2. Licencing
3. Interconnection rates and price regulation
4. Radio frequency allocation and assignment
5. Spectrum monitoring and enforcement
6. Universal service/access
7. Broadcasting (radio and TV transmission)
8. Broadcasting content
9. Internet content
10. IT
11. Tariff info, consumer education & complaints

CLUSTER 2

+

Regulatory regime

1. Types of licences provided
2. Licence exempt
3. Required Reference Interconnecion Offer (RIO)
4. Interconnection prices made public
5. QoS monitoring required
6. Infrastructure sharing for mobile operators allowed
7. Infrastructure sharing mandated
8. Co-location/site sharing mandated
9. Unbundled access to the local loop required
10. Secondary trading allowed
11. Bang migration allowed
12. Fixed number portability implemented
13. Mobile number partability implemented
14. Individual users allowed to use VoIP
15. National plan that involves broadband

CLUSTER 3

= **REGULATORY VARIABLE**

Source: ITU.

the value, the more conducive the regulatory environment to ICT developments. For the analyses in this section, data from the Regulatory Tracker have been extracted for clusters 1, 2 and 3, and combined into a single value per country per year (Figure 4.3). Cluster 4 is excluded because it is directly linked to competition, which is already considered in the models through a specific variable on competition (i.e. the HHI). The combined value of clusters 1 to 3 is used to test the link between regulation and prices of mobile-cellular and fixed-broadband services.

Choice of the model

The analysis was conducted through econometric modelling using panel regressions for up to 144 countries based on data for the five-year period from 2008 to 2013.

Panel data regression is a statistical technique which is used to assess how variations in a set of variables over a given time period relate to the changes in a variable that is modelled as the dependent variable. Panel regressions minimize problems of omitted variable bias (the omission of important variables) and multicollinearity (the co-variations of variables modelled as independent).

In addition, panel regressions have the advantage of discounting known and unknown region fixed effects. These are structural geographic conditions which generally hold constant over the time period examined, such as, for instance, similar pricing strategies of transnational operators present in one region, and common institutional frameworks that go beyond telecommunication regulation (e.g. the European Union *acquis*).[49] Such background fixed effects may be important for each region, but they do not enter into the variations studied across the observations as they hold constant for each region. In a similar way, the year-specific fixed effects are also considered. For instance, high volatility in the exchange rates from one year to another could have an impact on prices in USD, but this would be discounted based on the variation in the year fixed effects.

The model described in Box 4.2 was developed to test linear correlations between fixed-broadband and mobile-cellular prices and competition and regulation metrics, using panel regressions with fixed effects.

Prices for fixed-broadband and mobile voice services are modelled as two separate variables, as they follow distinctly separate patterns – fixed broadband has generally become subject to competition much later than mobile services and penetration levels are significantly lower for fixed broadband, especially in the developing world.

Final prices reflect a number of parameters that characterize a telecommunication market and are often the result of the simultaneous effects of technology choices, competition and regulation. At the same time, parameters like economic development, local geography, institutional quality, usage characteristics and others may also affect final pricing. The following explanatory variables have been retained in the model:

- It is well established that prices of telecommunication services vary with levels of economic development. Therefore, **gross national income per capita** (GNI p.c.) is included in the model to control for the differences in economic resources that play a role in shaping prices.

- The deployment of telecommunication networks requires large investments that operators evaluate depending on the demand for the service and the specific business case in each geographic area. The marginal cost of service provision in dense urban centres is often much lower than that in remote villages, pointing to the different cost per subscriber in urban and rural areas, as well as in dense and sparse agglomerations. These constraints are taken into account in the econometric model by including as a control variable the **percentage of population living in urban areas**.

- The degree of competition for the fixed-broadband and mobile-cellular markets is captured through the **Herfindahl-Hirschman Index (HHI),** which is a measure of market concentration. On the basis of the HHI, a few strong players may provide more competition than several small competitors. For instance, a mobile-cellular market with three players with one-third market share each would be more competitive (i.e. have a lower HHI) than a market with a dominant operator holding 60 per cent of the market and four additional operators with 10 per cent market share each. To test whether different degrees of market concentration have an impact on prices, the HHI is included in the econometric model.

- A **regulatory variable** is constructed on the basis of the Regulatory Tracker and considered as a proxy for the soundness of the regulatory framework in each country. This variable is included in the model in order to evaluate the effects of regulation on prices.

- Fixed-broadband prices collected by ITU are based on a minimum set of features: at least 256 kbit/s download speed and 1 GB of data allowance included per month. However, entry-level fixed-broadband plans in several countries offer higher speeds and larger data allowances. In order to measure how these enhanced features affect prices, a variable on **fixed-broadband speed** and another one on **capped data allowances** are included as controls in the model for fixed-broadband prices.

Box 4.2: Panel regression models for fixed-broadband and mobile-cellular prices

Two models are used for the regressions: one for fixed-broadband prices and another for mobile-cellular prices (voice and SMS). Both models test variations between prices and a number of variables for up to 144 countries over the five-year period from 2008 to 2013 using ordinary least squares (OLS) estimation.

$$P_{it} = \alpha + \beta X_{it} + \gamma_{rt} + \varepsilon_{it}$$

For i=1,…,n and t=1,..,T, where P_{it} is the dependent variable (fixed-broadband or mobile-cellular prices) in country *i* and year *t*; α is the constant of the estimation; X_{it} is the vector of explanatory variables described below for country i and year t; β is the vector of coefficients that quantify the effects that the explanatory variables have on P_{it}; γ_{rt} stands for the unobserved region and year fixed effects. These binary variables control for effects that are not explicitly accounted for in the X_{it} vector and correlate with a specific region and year. Essentially this component absorbs part of the unaccounted effects that would otherwise bias the coefficients β. Finally ε_{it} stands for an idiosyncratic error term. The dependent and independent variables are modelled using natural logarithms, except the dummy variables.

1. Dependent variables:

Fixed-broadband prices: This is the first dependent variable and represents the price by country and year for an entry-level fixed-broadband service in current USD. Data collected by ITU, see Annex 2 for more details on the methodology for the collection of fixed-broadband prices.

Mobile-cellular prices: This is the second dependent variable and represents the price by country and year for a low-user basket of mobile-cellular calls and SMS in current USD. Data collected by ITU, see Annex 2 for more details on the methodology for the collection of mobile-cellular prices.

Descriptive statistics of the dependent variables:

	Average		Standard deviation		Minimum		Maximum	
	2008	2013	2008	2013	2008	2013	2008	2013
Fixed-broadband prices	77.4	26.1	204.8	16.7	4.0	2.9	1718.8	108.5
Mobile-cellular prices	22.1	16.4	13.9	10.4	2.8	0.9	75.4	48.3

2. Explanatory variables

GNI p.c. – Gross national income per capita in current USD by year and country, as reported by the World Bank.

% urban population – Percentage of the population living in urban areas, as defined by national statistical offices (NSOs), and published by the World Bank.

Herfindahl-Hirschman Index for fixed broadband: $HHI_f = \sum_{i=1}^{m} \left(\frac{C_i}{TC}\right)^2$

with C_i being the number of fixed-broadband subscriptions of Internet Service Provider (ISP) i, and TC the total number of fixed-broadband subscriptions in the country. It is the sum of the squared market shares of each ISP calculated in terms of subscriptions. This index ranges from $\frac{1}{m}$ to 1, where m is the total number of ISPs in the market. The higher the value, the more the market is concentrated, i.e. higher HHI values indicate less competition and, conversely, lower HHI values indicate more competition. Data sourced from Informa.

Herfindahl-Hirschman Index for mobile cellular (voice and SMS): $HHI_m = \sum_{i=1}^{k} \left(\frac{L_i}{TL}\right)^2$

with L_i being the number of mobile-cellular subscriptions of firm i, and TL he total number of mobile-cellular subscriptions in the country. It is the sum of the squared market shares of each mobile-cellular service provider calculated in terms of subscriptions. As in the case of the HHI for fixed broadband, this ranges from $\frac{1}{k}$ to 1, where k is the total number of mobile-cellular service providers in the market. Data sourced from Informa.

Box 4.2: Panel regression models for fixed-broadband and mobile-cellular prices (continued)

Regulatory variable: The combined values of clusters 1 to 3 of the ITU ICT Regulatory Tracker. The Regulatory Tracker is an aggregate benchmark of each country's legal and regulatory frameworks using as a reference internationally recognized regulatory best practices. The following three clusters are used for the analysis:

Score of cluster 1: Regulatory authority

Score of cluster 2: Regulatory mandate

Score of cluster 3: Regulatory regime

The scores of each cluster are combined into a single value for the regulatory variable, ranging from 0 to 72, 72 being the most effective regulatory environment to foster ICT developments. Data collected by ITU, see www.itu.int/tracker for more information.

Fixed-broadband speed: Speed of the entry-level fixed broadband plan in Mbit/s. Data collected by ITU.

Fixed-broadband cap: Dummy variable that takes the value of 1 if the fixed-broadband plan includes a cap in the monthly data allowance, and 0 otherwise. Data collected by ITU.

Descriptive statistics of the dependent variables:

	Average		Standard deviation		Minimum		Maximum	
	2008	2013	2008	2013	2008	2013	2008	2013
GNI p.c.	14'707	16'439	18'813	20'521	370	440	85'580	102'610
Urban %	58.4	60.1	22.3	22.1	12.9	14.2	100	100
HHI fixed broadband	0.57	0.53	0.29	0.28	0.13	0.13	1.00	1.00
HHI mobile cellular	0.46	0.41	0.16	0.14	0.17	0.15	1.00	1.00
Regulatory variable	44.8	52.4	12.7	10.9	3.5	9	62	67.5
Fixed-broadband speed (Mbit/s)	1.0	5.2	1.5	9.9	0.25	0.25	8.2	50
Fixed-broadband cap (1=cap; 0=no cap)	0.23	0.36	0.43	0.48	0	0	1	1

All variables modelled as independent are weakly correlated among themselves, except GNI p.c. and percentage of urban population, which have a correlation coefficient of 0.63 (i.e. about 40 per cent of the variation of one variable can be explained by the variation of the other one). This does not affect the explanatory power of the overall model. However, it means that the impact of different levels of GNI p.c. and percentages of urban population on prices may be mixed in the results, and this needs to be considered when analysing the explanatory power of each of these two variables.

Note: Descriptive statistics calculated for 124 economies that have complete data for the two models.
Source: ITU.

Results for fixed broadband

The panel regression model for fixed-broadband prices has a medium explanatory power (an R-squared value of 0.41, where 1 represents a perfect fit of the model with the observations), and all the variables included are statistically significant except fixed-broadband speed (Table 4.13).

Competition in the market as measured by HHI is significantly correlated to prices, and the sign indicates that increased competition reduces prices. The model suggests that changing from two ISPs with 50 per cent market share each to three ISPs with 33 per cent market share each is linked to a reduction in prices of 5.8 per cent, other things being equal. Adding more operators is correlated with further reductions in prices, although the magnitudes of the reductions diminish: a 4.2 per cent reduction when moving from three to four ISPs; and 3.2 per cent when moving from four to five ISPs (assuming in all cases

Table 4.13: Panel regression results, fixed-broadband prices and regulation

Variable	Coefficient	Statistical significance	Interpretation
GNI p.c.	0.217 (0.034)	Highly significant (1% level)	A country with GNI p.c. of USD 11 000 is linked to prices 2.1% higher than a country with GNI p.c. of USD 10 000
Urban %	-0.221 (0.107)	Highly significant (1% level)	A country with 55% urban population is linked to prices 2.1% lower than a country with 50% urban population
HHI fixed broadband	0.148 (0.051)	Highly significant (1% level)	A change from a duopoly to a triopoly (with operators holding equal market shares) is linked to prices 5.8% lower
Regulatory variable	-0.447 (0.096)	Highly significant (1% level)	A 10% increase in the value of the regulatory variable is linked to a 4.2% drop in prices
Fixed-broadband cap	-0.372 (0.052)	Highly significant (1% level)	Fixed-broadband plans with data caps are linked to prices 31% lower than unlimited plans
Fixed-broadband speed	0.016 (0.023)	Not significant	
Constant	4.304 (0.506)	Highly significant (1% level)	
Year fixed effects	YES		Year fixed effects absorb annual effects not accounted for by the other variables
Region fixed effects	YES		Region fixed effects absorb regional specificities not accounted for by the other variables
Observations	801		
R-squared	0.408		

Note: Robust standard errors in parentheses. The independent and the dependent variables are modelled using natural logarithms, except for the dummy variables (fixed-broadband cap, year fixed effects, region fixed effects).
Source: ITU.

equal market shares for all ISPs in the market). The presence of fringe competitors would have a much smaller effect on prices: in a market with only two ISPs with equal market shares, the entry of a third ISP securing 10 per cent of the total market share would be correlated with a price drop of 2.7 per cent. This is less than half of the price reduction that would be achieved if the new operator obtained a third of the total market share. This is due in part to the nature of the HHI, which gives more weight to few competitors with large market shares than many with smaller market shares. A more detailed analysis would be necessary to determine to what extent small but disruptive operators may have an impact on prices.

By end 2013, fixed-broadband markets in developing countries were on average more concentrated than in developed countries (mean HHIs of 0.63 and 0.31, respectively);[50] in other words, competition was not as strong in the developing world. According to the results of the econometric model, if fixed-broadband markets in developing countries were to achieve the competition levels of developed countries, entry-level fixed-broadband prices could be reduced by as much as 10 per cent in the developing world. The effects of competition on prices could be particularly beneficial in the 21 developing countries that by end 2013 still had no competition in fixed-broadband services. Indeed, if the fixed-broadband market were liberalized in these countries and a second operator achieved 20 per cent of the market share, entry-level prices could go down as much as 5.5 per cent. Leaving aside four countries with very small populations and four small island states (where the specific geography and small population may justify the existence of a single operator),opening up the market to some competition in the remaining 13 developing economies would be a natural option with a view to boosting fixed-broadband penetration, which in all these countries is below 5 per cent.

Another important finding is that stronger regulatory frameworks (as measured by clusters

1-3 of the Regulatory Tracker) are linked to lower fixed-broadband prices.

In 2013, the sum of clusters 1-3 of the Regulatory Tracker was 59 on average in developed countries, compared with an average of 47 in developing countries.[51] This suggests that regulation in developed countries was more effective than in developing countries, and therefore more conducive to lower prices. According to the results of the econometric model, if the regulatory framework in developing countries converged on that prevailing in developed countries, fixed-broadband prices could be reduced by as much as 9.7 per cent. This highlights the importance of an enabling regulatory environment for affordable fixed-broadband prices. Although there is no one-size-fits-all approach, international regulatory best practices, such as the ones adopted by the global community of regulators at meetings of the ITU Global Symposium for Regulators (GSR)[52] and reflected in the ITU ICT Regulatory Tracker, may serve as a guideline for effective regulatory frameworks which can lay the foundations for affordable fixed-broadband services.

For instance, a country with a separate telecommunication/ICT regulator that has autonomy in decision-making, enforcement power, the right to impose sanctions or penalties and clear dispute-resolution mechanisms would have fixed-broadband prices 10.4 per cent lower than a country without these regulatory features, other things being equal.[53] A strong regulatory framework creates legal certainty for the players in the market, and this in turn fosters competition and ultimately contributes to achieving lower fixed-broadband prices.

The analysis of the variables that affect fixed-broadband prices cannot be reduced to competition only. The results previously discussed are only valid if considered in combination with the other explanatory variables included in the model.

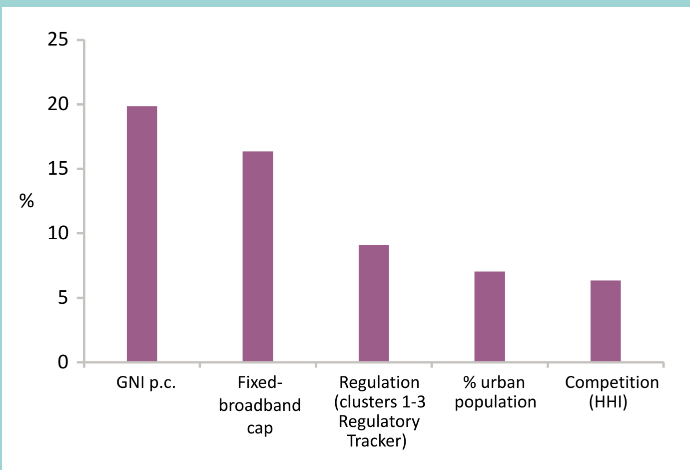
GNI per capita is an important variable because it controls for differences in economic development between countries. This is a very strong factor in the setting of prices, because it determines to a great extent how much customers are willing to pay for a given service. In a country with high economic levels, there are potentially more customers who can pay more for the same service than in a country with low economic levels. According to the results of the econometric model, a country with a GNI p.c. of USD 11 000 is correlated with prices 2.1 per cent higher than a country with GNI per capita of USD 10 000, other things being equal. Since GNI p.c. is a variable that tends to change slowly with time and depends on many different factors that go well beyond the ICT sector, it should be considered as an explanatory factor when benchmarking prices of ICT services internationally, rather than as an area of direct policy action.

Similarly, there is also a significant linked between the percentage of the population living in urban areas and fixed-broadband prices: a higher percentage of urban population correlates with lower prices. Clearly, concentration of the population in areas that can be more easily covered by fixed-wired infrastructure benefits operators because it reduces deployment costs. The results of the econometric model show that a 5 per cent higher urban population (as could happen, for instance, owing to the migration of population from rural areas to large cities) would result in fixed-broadband prices 1.1 per cent lower. It needs to be taken into account that the percentage of urban population in a country is significantly correlated with GNI p.c., so that economies with higher percentage of urban population tend to have higher GNI p.c. This means that the effects of both variables cannot be isolated in practice, and therefore both should be considered together as explanatory factors for the base levels of prices in a given country.

The model also suggests that the application of data caps by fixed-broadband service providers is correlated with cheaper entry-level fixed-broadband plans, other things being equal. The ITU data collection considers a minimum of 1 GB monthly consumption for fixed-broadband plans. Once that requirement is met, the cheapest plan is selected irrespective of whether it includes a data cap of 1 GB or more, or allows unlimited traffic. In 2013, entry-level fixed-broadband plans included a data cap in 35 per cent of the countries included in the fixed-broadband model, a higher percentage than in 2008 (24 per cent). Other variables being equal, fixed-broadband prices are cheaper in countries where data caps were enforced in entry-level fixed-broadband plans. This suggests that operators can offer cheaper prices in exchange for reduced data consumption, thus indicating that capacity in fixed-broadband networks is still an issue in several countries, i.e. the marginal cost of additional Internet data beyond 1 GB is still non-negligible in many countries.

Finally, different entry-level fixed-broadband speeds are not found to have a significant impact on prices. Since entry-level plans offer speeds at the lower end of those available in each country, this finding suggests that the starting speed offered in a country is not a determining factor for pricing; it may rather be the incremental speed offered for higher-end plans, which is priced as a premium. This is consistent with the strategies of several operators, which offered automatic upgrades of base speeds once networks are upgraded.[54]

Chart 4.23: Variation in fixed-broadband prices (%) explained by each variable, 2013



Note: Calculated taking as a reference the average of each variable and adding a standard deviation. In each case, the percentage displayed is the relative difference in fixed-broadband prices that would be obtained keeping all other variables constant. The calculation does not take into consideration the region fixed effects. All variables are negatively correlated with prices (i.e. an increase in their value is linked to a decrease in prices), except GNI p.c., which is positively correlated with prices. GNI p.c. and % urban population are correlated, so the explanatory power of these variables needs to be considered together.

Source: ITU.

Chart 4.23 provides an approximation of the explanatory power of each factor in the variations in fixed-broadband prices observed across countries in 2013. Values are calculated taking as a reference the average of each variable and evaluating the impact that a change equal to the standard deviation of that variable would have in terms of fixed-broadband prices, keeping all other factors constant. The results show that differences in fixed-broadband prices (in USD) across countries are largely explained by differences in GNI p.c. and in the percentage of urban population, since both variables are correlated. However, these two variables are differently correlated with prices, so they have opposite effects. A high percentage of urban population is associated with lower fixed-broadband prices because of the lower costs of deployment of wired networks, whereas higher GNI p.c. is associated with higher prices in USD because of higher purchasing power. The combination of these two variables may partially balance out and thus ultimately have a weaker final effect on prices.

Factors that are purely attributable to the ICT sector, such as operators' strategies on data caps, competition in the fixed-broadband market and the ICT regulatory environment, may together be a greater determinant for fixed-broadband prices than the price difference explained by GNI p.c. and percentage of the population living in urban areas.

Based on the econometric model presented, it can be estimated that about 9 per cent of the variation in entry-level fixed-broadband prices across countries in 2013 was due to differences in the regulatory framework. Different levels of competition across countries are estimated to account for 6 per cent of the variations observed in prices. This provides a quantitative assessment of the benefits that competition and enabling regulation can bring to fixed-broadband markets, particularly in developing countries, as previously highlighted. Differences in fixed-broadband prices are not just a matter of economic and geographic divides, but also hinge on an adequate regulatory environment in the markets. It is therefore in the hands of policy-makers and regulators to set the conditions for more affordable fixed-broadband prices based on increased competition.

Results for mobile cellular

The results of the panel regression for mobile-cellular prices (voice and SMS) indicate that the model constructed has a medium explanatory power (an R-squared value of 0.41, where 1 represents a perfect fit) and all variables included are statistically significant (Table 4.14).

Competition in the market as measured by HHI is significantly correlated to prices, and the sign indicates that increased competition reduces prices. For example, the model predicts that in a market with two mobile-cellular operators sharing the market equally, the entry of a new operator securing 10 per cent of the market is correlated with a 3.7 cent decrease in prices. If the new entrant achieved a 20 per cent market share, prices would be reduced by 6.4 per cent compared with the initial situation with only two operators, and by 7.7 per cent if the new entrant reached a 30 per cent market share. The presence of fringe competitors would have a much smaller effect on prices due to the nature of the HHI, which gives more weight to few competitors with large market shares than many with smaller market shares. A more detailed analysis would be necessary to determine to which extent small but disruptive operators, such as mobile virtual network operators (MVNOs), may have an impact on prices.

Competition in mobile-cellular markets is stronger than in fixed-broadband markets, and differences in competition levels across mobile-cellular markets are on average smaller. Nevertheless, mobile-cellular markets in developing countries were on average more concentrated than in developed countries at end 2013 (mean HHI of 0.46 and 0.35, respectively).[55]

Table 4.14: Panel regression results, mobile-cellular prices and regulation

Variable	Coefficient	Statistical significance	Interpretation
GNI p.c.	0.147 (0.024)	Highly significant (1% level)	A GNI p.c. of USD 11 000 is linked to prices 1.4% higher than a GNI p.c. of USD 10 000
Urban %	-0.284 (0.071)	Highly significant (1% level)	A country with 55% urban population is linked to prices 2.7% cheaper than a country with 50% urban population
HHI mobile cellular	0.201 (0.082)	Significant (5% level)	A change from a duopoly to a triopoly (with operators holding equal market shares) is linked to prices 7.8% lower
Regulatory variable	-0.080 (0.045)	Significant (10% level)	A 10% increase in the value of the regulatory variable is linked to a 0.8% drop in prices
Constant	0.675 (0.278)	Significant (5% level)	
Year fixed effects	YES		Year fixed effects absorb annual effects not accounted for by the other variables
Region fixed effects	YES		Region fixed effects absorb regional specificities not accounted for by the other variables
Observations	805		
R-squared	0.409		

Note: Robust standard errors in parentheses. The independent and the dependent variables are modelled using natural logarithms.
Source: ITU.

According to the results of the econometric model, if mobile-cellular markets in developing countries were to achieve the competition levels prevailing in developed countries, mobile-cellular prices could be reduced by up to 5 per cent in the developing world.

Regulation is also found to be correlated with mobile-cellular prices, but with a weaker coefficient than in the case of fixed-broadband services. The 10 per cent of countries with the lowest regulatory value are all (except one) from the developing world, and have an average regulatory value of 23 compared with a global average of 51. If measures such as making interconnection prices public, publishing reference interconnection offers (RIO), allowing infrastructure sharing for mobile operators, permitting secondary trading of spectrum, allowing band migration and implementing mobile number portability were implemented in these countries, the improvements in regulation could result in a 3 per cent decrease in prices.

This is a modest decrease when compared with the reduction in mobile-cellular prices that could be achieved in those developing countries with highly concentrated markets, i.e. with an HHI above 0.6, which means that there is a dominant operator holding more than 70 per cent of the market share. If the market share of the dominant operator were reduced to 50 per cent through the entry of new players or the consolidation of existing ones, so that there were at least three players in the market with more than a 10 per cent market share each, prices could be reduced by no less than 7 per cent. This highlights the benefits that stronger competition can have on mobile-cellular prices in highly concentrated markets.

The link between competition, regulation and prices in mobile-cellular markets discussed is only valid if considered in combination with the other explanatory variables included in the model.

As in the case of fixed-broadband, GNI per capita is an important variable because it controls for differences in economic development between countries, and thus differences in purchasing power. For instance, the model predicts that, in a country with a GNI per capita of USD 11 000, prices are 1.4 per cent higher than in a country with a GNI p.c. of USD 10 000, other things being equal.

Urbanization is significantly related to final prices for mobile-cellular services: a 5 per cent increase in the percentage of the population in urban areas is correlated with prices 2.7 per cent cheaper. This may be explained by the fact that infrastructure deployment in sparse and rural areas is more costly than in dense urban areas. Urbanization and GNI p.c. are significantly correlated, and therefore the effects of both variables need to be considered together as a reference for comparisons across countries, so that the impact of regulation and competition on prices is assessed discounting the effects of these two variables.

Chart 4.24 provides an estimation of the explanatory power of each factor in the variations in mobile-cellular prices observed across countries in 2013. Differences in mobile-cellular prices across countries are smaller than the differences in fixed-broadband prices and, as a result, the impact of the different explanatory variables is smaller.

The variable that has the highest explanatory power is GNI p.c., which accounts for an estimated 13 per cent of the variations in mobile-cellular prices observed in 2013. As previously highlighted, GNI p.c. is correlated with the percentage of urban population, which also has a significant explanatory power (9 per cent of the differences). Since the effects of both factors on mobile-cellular prices are opposite, the impact of these variables may almost balance out and have a limited effect on prices. Compared with fixed-broadband prices, GNI p.c. has a weaker effect on the final price in the case of mobile-cellular services. This suggests that economic levels are less of a determinant, probably because prices were already low enough in 2008 (for a lower-user voice and SMS basket) to be affordable for most of the population and, it being a mature market, competition is a stronger determinant of pricing trends.

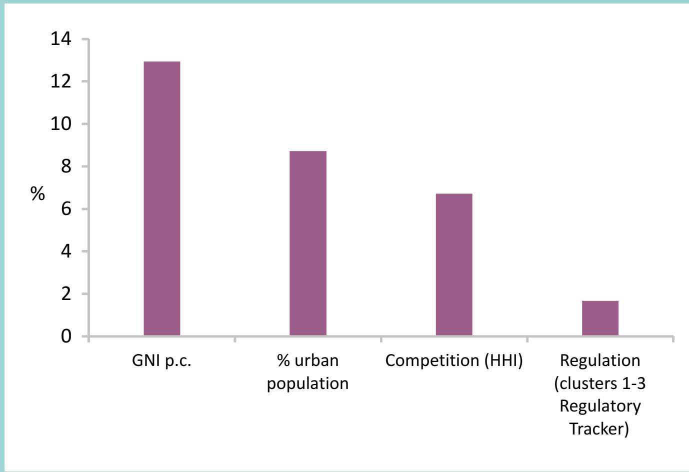
Different competition levels may account for an estimated 7 per cent of the differences in mobile-cellular prices observed across countries. Taking into consideration that differences in prices are smaller than in fixed-broadband services,[56] this finding highlights the importance of competition as a driver for lower prices in mobile-cellular markets.

Regulation is found to have a weak explanatory power of only 2 per cent, suggesting that regulation is less of an issue in mobile-cellular markets. This may be because the regulation in place in most countries (e.g. regulation of mobile termination rates) already supports the development of competition in the market, since the degree of liberalization achieved in mobile-cellular markets is high when compared with that prevailing in fixed-broadband markets. In addition, the deployment of mobile networks tends to be less capital-intensive than the deployment of fixed-broadband networks, and disruptive players, such as MVNOs, may enter a market with relatively low upfront capital investments, and yet enjoy a stronger position than resellers have in fixed-broadband markets. This could explain the dynamism observed in mobile-cellular markets, and why light-touch regulation and a liberal spectrum assignment approach may already be conducive to competition and lower prices in mobile-cellular services, whereas in fixed-broadband markets stronger regulatory action may be needed because essential facilities – such as the local loop or the international gateway – may be controlled by the incumbent.

Conclusions

On the basis of the results of the model presented in this section, it is possible to draw the following overall conclusions on the impact of competition and regulation on fixed-broadband and mobile-cellular prices:

Chart 4.24: Variation in mobile-cellular prices (%) explained by each variable, 2013



Note: Calculated taking as a reference the average of each variable and adding a standard deviation. In each case, the percentage displayed is the relative difference in mobile-cellular prices that would be obtained keeping all other variables constant. The calculation does not take into consideration the region fixed effects. All variables are negatively correlated with prices (i.e. an increase in their value is linked to a decrease in prices), except GNI p.c., which is positively correlated with prices. GNI p.c. and % urban population are correlated, so the explanatory power of these variables needs to be considered together.

Source: ITU.

- Fixed broadband: Different regulation may account for almost 10 per cent of the differences in prices observed across countries. This highlights the importance of considering international best practices as a guide for implementing regulatory actions that promote efficiency, legal certainty and a level playing field for all operators. Different competition levels may explain around 6 per cent of the differences in prices observed across countries. This confirms that competition plays an important role in determining prices in fixed-broadband markets. Another factor that is found to be relevant in fixed-broadband prices is the existence of data caps, which is correlated with lower prices. This may indicate that fixed-broadband capacity may still be an issue in several countries,

Table 4.15: ICT Price Basket and sub-baskets, 2013

Rank	Economy	IPB 2013	Fixed telephone sub-basket as a % of GNI per capita, 2013	Mobile-cellular sub-basket as a % of GNI per capita, 2013	Fixed Broadband sub-basket as a % of GNI per capita, 2013	GNI p.c., USD, 2013*
1	Macao, China	0.2	0.2	0.1	0.3	64'691
2	Singapore	0.3	0.2	0.2	0.4	54'040
3	Kuwait	0.3	0.3	0.4	0.4	45'889
4	Qatar	0.4	0.1	0.3	0.8	85'550
5	Norway	0.4	0.3	0.3	0.6	102'610
6	Hong Kong, China	0.4	0.4	0.2	0.7	38'420
7	Switzerland	0.4	0.5	0.3	0.5	81'760
8	Russian Federation	0.5	0.3	0.6	0.5	13'860
9	Luxembourg	0.5	0.4	0.4	0.6	72'528
10	Austria	0.5	0.7	0.3	0.6	48'590
11	Denmark	0.6	0.6	0.2	0.9	61'110
12	Iran (I.R.)	0.6	0.0	0.5	1.2	5'780
13	Sweden	0.6	0.6	0.4	0.8	59'130
14	Australia	0.6	0.6	0.3	1.0	65'520
15	United States	0.7	0.5	0.8	0.7	53'670
16	Finland	0.7	0.9	0.4	0.8	47'110
17	Iceland	0.7	0.6	0.6	0.9	43'930
18	Japan	0.7	0.6	0.9	0.6	46'140
19	Oman	0.7	0.5	0.4	1.2	25'503
20	Venezuela	0.7	0.1	1.0	1.0	12'550
21	Germany	0.7	0.7	0.5	1.0	46'100
22	United Arab Emirates	0.8	0.3	0.3	1.7	39'006
23	Mauritius	0.8	0.7	0.8	0.8	9'300
24	Trinidad & Tobago	0.8	0.2	1.1	0.9	15'760
25	Cyprus	0.8	1.1	0.4	1.0	26'654
26	Korea (Rep.)	0.8	0.3	0.9	1.3	25'920
27	Canada	0.8	0.7	0.7	1.0	52'200
28	Bahrain	0.9	0.3	0.7	1.6	19'756
29	France	0.9	0.8	1.1	0.8	42'250
30	Lithuania	0.9	1.0	0.8	1.0	13'958
31	Belgium	0.9	1.0	0.9	0.9	45'210
32	Netherlands	0.9	0.8	1.0	0.9	47'440
33	United Kingdom	0.9	1.0	1.3	0.5	39'110
34	Kazakhstan	1.0	0.5	1.2	1.3	11'380
35	Belarus	1.0	0.2	1.3	1.6	6'720
36	Brunei Darussalam	1.0	0.5	0.7	1.9	33'002
37	Malta	1.0	0.8	1.2	1.1	19'927
38	Costa Rica	1.0	0.6	0.5	2.0	9'550
39	Sri Lanka	1.0	1.1	0.4	1.6	3'170
40	Israel	1.0	0.6	1.2	1.3	34'120
41	Ireland	1.1	1.2	1.3	0.6	39'501
42	Italy	1.1	1.1	1.2	0.9	34'400
43	Slovenia	1.2	1.0	1.3	1.3	23'058
44	Latvia	1.2	0.9	1.0	1.7	14'201
45	Panama	1.2	1.0	1.4	1.2	10'700
46	Uruguay	1.2	0.9	1.7	1.1	15'180
47	Bahamas	1.2	0.9	1.0	1.7	20'806
48	Saudi Arabia	1.2	1.2	0.6	1.8	26'200
49	New Zealand	1.3	1.3	0.5	2.1	35'875
50	Poland	1.3	1.7	1.0	1.1	12'960
51	Estonia	1.3	0.8	1.6	1.5	17'370
52	Portugal	1.3	1.4	0.9	1.6	20'670
53	Seychelles	1.3	0.9	1.5	1.6	12'530
54	Slovakia	1.4	1.2	1.1	1.8	17'372
55	Spain	1.4	1.3	1.6	1.3	29'180
56	Azerbaijan	1.4	0.4	1.7	2.1	7'350
57	Malaysia	1.4	1.0	0.8	2.4	10'400
58	Croatia	1.5	1.3	1.5	1.6	13'330
59	Greece	1.6	1.3	2.2	1.2	22'530
60	Maldives	1.6	0.7	1.2	2.8	5'600
61	Tunisia	1.6	1.4	1.6	1.7	4'360
62	Czech Republic	1.6	1.8	1.7	1.4	18'060
63	China	1.7	0.9	0.7	3.5	6'560
64	Romania	1.7	1.6	2.5	1.2	9'060
65	Mexico	1.8	2.3	1.4	1.6	9'940
66	Ukraine	1.8	1.3	2.2	1.9	3'960
67	Turkey	1.8	1.3	2.9	1.3	10'950
68	Egypt	1.8	1.0	2.1	2.5	3'160
69	Viet Nam	1.9	1.3	2.5	2.0	1'730
70	Mongolia	2.0	1.7	1.5	2.7	3'770
71	Bhutan	2.1	0.7	1.4	4.2	2'460
72	Montenegro	2.1	1.3	1.9	3.1	7'260
73	St. Kitts and Nevis	2.1	1.1	2.0	3.3	13'460
74	Lebanon	2.2	1.4	3.0	2.1	9'870
75	Barbados	2.3	1.7	1.7	3.3	15'231
76	Georgia	2.3	0.8	2.1	4.0	3'570
77	Armenia	2.3	0.9	2.6	3.5	3'790
78	Hungary	2.4	2.2	2.4	2.7	12'534
79	Chile	2.5	2.4	2.0	3.0	15'230
80	Uzbekistan	2.5	0.6	1.8	5.1	1'900
81	Thailand	2.5	1.4	1.2	5.0	5'370
82	Suriname	2.5	0.4	1.9	5.4	9'260
83	Bosnia and Herzegovina	2.6	2.0	3.7	2.0	4'740

Table 4.15: ICT Price Basket and sub-baskets, 2013 (continued)

Rank	Economy	IPB 2013	Fixed telephone sub-basket as a % of GNI per capita, 2013	Mobile-cellular sub-basket as a % of GNI per capita, 2013	Fixed Broadband sub-basket as a % of GNI per capita, 2013	GNI p.c., USD, 2013*
84	India	2.6	1.9	2.2	3.7	1'570
85	Antigua & Barbuda	2.7	1.2	1.8	5.1	12'910
86	TFYR Macedonia	2.7	2.2	2.8	3.2	4'800
87	Serbia	2.8	1.3	3.2	3.8	5'730
88	Algeria	2.9	1.3	2.9	4.4	5'290
89	Jordan	2.9	2.3	1.9	4.6	4'950
90	Brazil	3.0	2.5	5.0	1.4	11'690
91	Peru	3.0	2.4	2.4	4.1	6'390
92	Colombia	3.1	2.7	3.4	3.1	7'560
93	South Africa	3.2	3.3	3.4	2.9	7'190
94	Bulgaria	3.2	1.9	5.7	1.9	7'030
95	Ecuador	3.2	1.5	3.7	4.4	5'510
96	Botswana	3.3	2.2	1.6	6.1	7'730
97	Grenada	3.5	2.2	3.5	4.7	7'460
98	Indonesia	3.5	1.3	2.3	6.9	3'580
99	Jamaica	3.6	2.7	2.1	5.9	5'220
100	Dominican Rep.	3.6	3.2	2.9	4.5	5'620
101	Morocco	3.6	0.9	5.2	4.7	3'030
102	Bangladesh	3.8	3.5	1.9	5.9	900
103	Gabon	3.8	5.7	2.2	3.4	10'650
104	Moldova	3.8	0.2	5.0	6.2	2'460
105	Dominica	3.9	2.1	3.0	6.7	6'760
106	Guyana	4.0	1.0	3.2	7.8	3'750
107	St. Vincent and the Grenadines	4.1	2.0	4.1	6.1	6'580
108	Paraguay	4.2	2.5	3.6	6.3	4'040
109	St. Lucia	4.2	2.3	4.2	6.1	7'090
110	Albania	4.3	1.8	8.1	2.9	4'700
111	Fiji	4.5	2.7	5.6	5.1	4'430
112	Sudan	4.6	3.9	3.9	6.1	1'130
113	El Salvador	4.8	3.5	5.8	5.1	3'720
114	Namibia	4.9	2.0	2.1	10.6	5'840
115	Cape Verde	5.8	3.6	10.4	3.5	3'630
116	Pakistan	6.0	4.3	3.2	10.7	1'380
117	Philippines	6.1	6.1	3.7	8.6	3'270
118	Kyrgyzstan	6.2	1.3	5.4	11.9	1'200
119	Nepal	6.4	4.4	4.4	10.4	730
120	Honduras	6.5	3.5	7.5	8.6	2'180
121	Guatemala	6.5	2.0	7.8	9.8	3'340
122	Angola	6.9	3.9	4.7	12.2	5'010
123	Lao P.D.R.	7.8	3.9	5.9	13.7	1'460
124	Nigeria	7.9	3.2	2.8	17.6	2'760
125	Equatorial Guinea	8.1	1.6	2.5	20.4	14'320
126	Samoa	8.6	4.3	6.4	15.0	3'430
127	Belize	8.8	5.4	8.1	12.9	4'660
128	Cambodia	9.2	4.8	7.9	15.0	950
129	Timor-Leste	9.2	6.6	4.7	16.4	3'580
130	Bolivia	9.5	11.3	5.4	11.8	2'550
131	Ghana	9.7	2.8	3.5	22.7	1'760
132	Swaziland	10.3	2.0	6.6	22.2	3'080
133	Marshall Islands	11.2	13.1	6.3	14.3	4'200
134	Nicaragua	12.4	4.6	18.5	14.0	1'780
135	Lesotho	13.6	8.1	12.5	20.0	1'550
136	Micronesia	14.7	27.8	4.8	11.5	3'430
137	Afghanistan	17.2	2.8	10.1	38.6	700
138	Mauritania	19.4	18.7	16.0	23.7	1'060
139	S. Tomé & Principe	20.1	6.7	10.3	43.4	1'470
140	Côte d'Ivoire	21.0	17.2	14.1	31.7	1'380
141	Ethiopia	22.1	2.2	8.8	55.1	470
142	Kenya	22.2	16.8	5.0	44.8	930
143	Vanuatu	22.5	16.0	9.9	41.6	3'130
144	Tanzania	24.3	19.3	17.9	35.7	630
145	Senegal	24.3	13.4	18.6	40.9	1'070
146	Uganda	25.1	21.1	22.1	32.2	510
147	Zambia	26.6	5.4	14.3	60.1	1'480
148	Haiti	29.4	7.7	14.5	66.1	810
149	Zimbabwe	29.5	14.9	29.8	43.9	820
150	Cuba	30.0	0.0	4.3	85.8	6'014
151	Cameroon	31.0	19.1	16.7	57.2	1'270
152	Mozambique	34.4	26.6	25.9	50.7	590
153	Kiribati	37.9	5.5	8.3	110.5	2'620
154	Benin	39.0	19.4	20.9	76.9	790
155	Rwanda	40.5	9.0	12.4	642.5	620
156	Solomon Islands	40.5	8.2	13.2	202.1	1'610
157	Papua New Guinea	41.3	7.8	16.1	266.0	2'010
158	Burkina Faso	42.0	25.4	20.9	79.8	670
159	Mali	42.1	14.2	26.5	85.6	670
160	Burundi	47.5	5.9	36.6	220.5	280
161	Eritrea	47.7	11.2	31.8	3909.8	490
162	Togo	52.5	19.0	38.5	102.2	530
163	Niger	59.3	43.4	34.4	176.2	410
164	Central African Rep.	66.6	48.2	51.6	2193.6	320
165	Madagascar	69.7	56.6	52.5	159.4	440
166	Malawi	70.2	54.2	56.3	241.2	270

Note: * Data correspond to the GNI per capita (Atlas method) in 2013 or latest available year adjusted with the international inflation rates.
Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.

and that policy-makers and regulators may need to look at the actions that can be taken to ease capacity bottlenecks. Based on the econometric model, it can be concluded that factors that are purely attributable to the telecommunication sector, such as operators' strategies on data caps, competition in the fixed-broadband market and the ICT regulatory environment, are together more of a determinant for fixed-broadband prices than exogenous factors, such as overall levels of economic development. Thus, policy-makers and regulators can contribute significantly to setting the conditions for more affordable fixed-broadband prices, particularly in those developing countries where fixed-broadband prices remain unaffordable for the majority of the population.

- Mobile cellular: Differences in mobile-cellular prices across countries are smaller than the differences in fixed-broadband prices, and competition is stronger in mobile-cellular markets. Different competition levels largely explain the differences in mobile-cellular prices observed across countries (an estimated 7 per cent), whereas differences in the regulatory environment have less of an impact in setting mobile-cellular prices, since regulation in most countries is already open enough to allow competition. Regulatory efforts should be focused on ensuring that higher levels of competition are achieved, particularly in those countries where dominant operators still hold market shares above 60 per cent, thus limiting the possible benefits that competition may yield in terms of more affordable prices for customers. Efficient spectrum allocation and assignment could allow the entry of new players or the consolidation of stronger alternative operators and thus help to spur competition in some markets, even if penetration levels are already high.

Endnotes

1 Examples of international organizations that have specific programmes in the area of income inequality include IMF (http://www.imf.org/external/np/fad/inequality), OECD (http://www.oecd.org/social/inequality.htm) and the World Bank (http://www.worldbank.org/en/topic/isp).

2 For example, if country A and country B have the same price in USD for any given ICT service, but in country A prices of other products are in general cheaper (in USD), then applying PPP exchange rates to the price of the ICT service in country A will make this service more expensive. That is so because, compared to country B, in country A the same amount of USD (exchanged into national currency at market exchange rates) can buy more products or services. Therefore, the ICT service in country A is more expensive in terms of what could be bought with that amount in each country. The International Comparison Program (ICP) is the major global initiative to produce internationally comparable price levels. For more information on the PPP methodology and data, see http://icp.worldbank.org.

3 GNI takes into account all production in the domestic economy (i.e. GDP) plus the net flows of factor income (such as rents, profits and labour income) from abroad. The Atlas method smooths exchange-rate fluctuations by using a three-year moving average, price-adjusted conversion factor. See: http://data.worldbank.org/indicator/NY.GNP.PCAP.CD.

4 Voice over Internet services, such as Skype or VoipBuster, are excluded from the analysis in this section because they require an Internet connection and do not have a guaranteed quality of service. They are considered under broadband services.

5 Source: Census of India 2011. Mode of communication 2001-2011. Available at: http://censusindia.gov.in/2011census/hlo/Data_sheet/India/Communication.pdf.

6 Prices for each service are calculated on the basis of a low-user basket that defines the number of calls, minutes and SMS (in the case of mobile-cellular plans) that are consumed per month. For more information on the baskets and the price-collection methodology, see Annex 2.

7 Prepaid handset-based mobile-broadband plans were only available in 122 out of the 140 countries included in the comparison with the other telecommunication services. Therefore, the average for handset-based mobile-broadband prices provides only an indication, and is not strictly comparable with the other averages.

8 In the case of Sri Lanka, the entry of Bharti Airtel as the fifth mobile network operator in the market led to an aggressive price war. This prompted the regulator to impose termination rates and a floor rate for national mobile calls with the aim of protecting mobile operators' margins. At present, Sri Lanka continues to have some of the cheapest mobile-cellular prices in the world and the mobile market has achieved a stable financial situation. For a more detailed analysis of the ICT sector in Sri Lanka, see Galpaya (2011) and the presentation of the Telecommunications Regulatory Commission of Sri Lanka on the impact of the floor rate, available at: http://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Indonesia-12/pdf/Session4_SriLanka_Nishantha.pdf.

9 Based on 2012 and 2011 ITU data for countries accounting for 97 per cent of global fixed (wired)-broadband subscriptions, it is estimated that 59 per cent of total fixed (wired)-broadband subscriptions were through ADSL in 2012.

10 References to income levels are based on the World Bank classification, see http://data.worldbank.org/about/country-classifications/country-and-lending-groups.

11 The Communications Commission of Kenya (CCK) issued mobile virtual network operator licences to three operators in April 2014. For more information, see CCK's press release available at: http://www.cck.go.ke/news/downloads/MVNO.pdf.

12 Although four international operators compete in the Kenyan mobile-cellular market, the dominant mobile operator (Safaricom) holds a market share of almost 70 per cent, and on-net traffic accounts for 87 per cent of the total. Mobile number portability is yet to make an impact in the market, with only 267 in-ports in the period October-December 2013 (CCK, 2014). These data suggest there is limited competition among operators.

13 Advanced mobile technologies refer to standards agreed by the ITU Radiocommunication Assembly for next-generation mobile technologies – IMT-Advanced – such as LTE-Advanced and WirelessMAN-Advanced. For more details on these standards, see http://www.itu.int/net/pressoffice/press_releases/2012/02.aspx.

14 Cuba is excluded from the world and developing averages of fixed-broadband prices, because fixed-broadband services in the island are only available to business customers, the only Internet access available to residential customers being dial-up.

15 For more details on Eircom's FTTH roll-out, see http://www.eircom.net/efibreinfo/map.

16 The most visited websites in Tunisia by December 2011 were predominantly in English. Initiatives to promote Arab digital content in Tunisia include, for instance, the e-government portal www.tunisie.gov.tn. For more information, see p. 122 in ITU (2012a).

17 For a map of the availability of Qualitynet fixed-broadband services, see http://www.qualitynet.net/map/qnetmap.htm.

18 Mauritel reported 7 352 fixed Internet subscriptions by end 2013, 97 per cent of which trhough ADSL (source: Maroc Telecom, http://www.iam.ma/Groupe/Institutionnel/Qui-Sommes-Nous/Filiales_Participations/Pages/Mauritel.aspx), out of a total of 7 532 fixed (wired)-broadband subscriptions in the country.

19 For more information on the tariffs offered by ETCSA for Internet access, see http://www.etecsa.cu/?page=internet_conectividad&sub=internet.

20 For instance, the latest Computer Literacy Survey in Sri Lanka (2009) found that only 20 per cent of the household population (aged 5 - 69) could use a computer on their own (Department of Census and Statistics Sri Lanka, 2009). The Ministry of Education of Sri Lanka and eSri Lanka have undertaken several actions to improve digital literacy (Galpaya, 2011).

21 Sources: TEAMS' website (http://www.teams.co.ke) and EASSy's website (http://www.eassy.org).

22 Sources: Orange press release for the launch of the ACE cable, https://www.ace-submarinecable.com/ace/media/ace_fr/UPL389171684192165237_CP_Orange_ACE_FR_191212.pdf, and for the go-live of WACS, see http://www.oafrica.com/broadband/west-africa-cable-system-wacs-technically-goes-live.

23 For more information on Rogers' "Share Everything" plans, see http://www.rogers.com/web/content/share-everything?asc_refid=shareeverything. For the details of Verizon's "MORE Everything" plan, see http://www.verizonwireless.com/wcms/consumer/shop/shop-data-plans/more-everything.html.

24 The details of the different '4G' plans offered by Tigo can be found on the following websites: http://www.tigo.com.bo/personas/planes-y-promociones/Internet-movil-en-tu-modem, http://www.tigo.com.co/4g, http://www.tigo.com.gt/personas/internet-movil/internet-movil-tigo-4g and https://www.tigo.com.py/contenido/para-navegar-con-el-modem.

25 Data for mobile-broadband services have been collected since 2012 through the ITU ICT Price Basket Questionnaire, which is sent out annually to all ITU Member States/national statistical contacts.

26 In 2013, the average price in USD for an entry-level fixed-telephone service was 49 per cent cheaper in developing countries than in developed countries, and 14 per cent cheaper in PPP$. Likewise, a low-user mobile-cellular basket was 41 per cent cheaper in USD, and 7 per cent cheaper in PPP$.

27 For more information on MTN Cameroon tariffs, see www.mtncameroon.net, and for Orange Côte d'Ivoire mobile-broadband plans, see http://www.orange.ci/menu-mobile-3g/pass-internet-3g.html.

28 The UMTS auctions took place in 2000 and 2001 in Europe (van Damme, 2002 and OECD, 2001), preceded only by Japan and the Republic of Korea, where 3G licences were awarded in 2000. In most developing countries, on the other hand, 3G licences were not granted until much later. In large emerging countries such as China and India, for instance, 3G licences were awarded in 2009 and 2010, respectively. See for instance Xia (2011) and India's Department of Telecommunication press release: http://www.dot.gov.in/as/Auction%20of%20Spectrum%20for3G%20&%20BWA/Auction%20results/3G_Auction_-_Final_Results.pdf.

29 For example, outflows of profits generated by a multinational operating in country A and transferred back to the country of ownership of the multinational would count in country A's GDP, but not in its GNI.

30 The World Bank classification by income groups is available at: http://data.worldbank.org/about/country-classifications/country-and-lending-groups.

31 Household incomes include wages, salaries, self-employment incomes, capital and property income, private transfers and social security transfers from public sources. For more information, see the 2012 OECD Terms of Reference for the OECD Project on the Distribution of Household Incomes, available at: http://www.oecd.org/els/soc/IDD-ToR.pdf.

32 Individual income is calculated by dividing total household income by the number of persons or using equivalence scales. Equivalence scales are used to account for the fact that the needs of a household do not grow proportionally with its size owing to economies of scale in consumption, e.g. a household with four persons does not pay for four fixed-broadband subscriptions, but rather shares the cost of one connection. Other needs, such as electricity or housing space, follow similar patterns that allow savings in larger households. For more information on the most common equivalence scales, see the OECD note available at: http://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf.

33 The first decile corresponds to the 10 per cent of the population with the lowest income. Conversely, the tenth decile corresponds to the 10 per cent of the population with the highest income.

34 For a discussion on the differences between income and consumption expenditure as welfare indicators, see for instance the World Bank's website on measuring poverty: http://go.worldbank.org/W3HL5GD710.

35 Differences in the equivalence scales of the source data used in this chapter are roughly corrected using ITU estimates on the number of inhabitants per household for each country. World Bank PovcalNet data on income distribution are published per capita, and figures from the OECD Database on Income Distribution are equivalized using the square root scale.

36 For OECD countries, household income is estimated by multiplying the equivalized household income by the square root of the average number of inhabitants per household in the country. For non-OECD countries, household income or consumption is estimated as the per capita household income or consumption multiplied by the average number of inhabitants per household in the country.

[37] Angola has a GNI per capita almost ten times higher than that of Uganda, and relatively high compared with most African countries (USD 5 010 per capita in Angola by end 2013). A very significant share of Angola's GNI depends on the oil and mineral industries. According to 2008/9 survey data, mean household consumption in Angola was almost the same as in Uganda, suggesting that the high GNI p.c. is mainly attributable to some specific industries, rather than to an overall higher level of income and consumption expenditure by most households.

[38] Data on income distribution are aggregated per household and then equally attributed to each member of the household. As a result, people who may not have any direct income are attributed a proportional part of the household's total income. In addition, data on income distribution are averaged per decile. If the price of a fixed-broadband plan represents less than 5 per cent of the average income of the first decile in a country, this does not mean that all households can afford the service. In the first decile there will be some households with incomes below the average of the decile and for which a fixed-broadband plan may still be unaffordable. In conclusion, the data presented do not determine whether 100 per cent of a population within a country can afford a fixed-broadband plan, but rather provide an approximation based on 10 per cent population intervals. Thus, if a fixed-broadband plan costs less than 5 per cent of household disposable income for all deciles, it can be stated that more than 90 per cent of the population live in a household where a basic fixed-broadband plan costs less than 5 per cent of the total household income.

[39] Household disposable income or consumption figures are equivalized using the square root scale to account for economies of scale in large households. The World Bank's PovcalNet data are adjusted using ITU estimates on the average number of inhabitants per household.

[40] See Footnote 10.

[41] For examples regarding broadband markets, see Bouckaert, Van Dijk and Verboven (2010), Calzada and Martinez (2014), Nardotto, Valletti and Verboven (2012) and Gruber and Koutroumpis (2013). Regarding mobile services, see for instance Gruber and Verboven (2001), Grzybowski (2005) and Koski and Kretschmer (2005).

[42] Gruber and Verboven (2001), Gruber and Koutroumpis (2013).

[43] North (1990), North and Thomas (1973), Levy and Spiller (1994, 1996).

[44] Levy and Spiller (1996).

[45] Waverman and Koutroumpis (2011), Fink, Mattoo and Rathindran (2002), Wallsten (2001), Gutierrez and Berg (2000), Ros (1999, 2003), Guttierez (2003), Gual and Trillas (2004).

[46] The Brazilian National Broadband Plan (see Box 3 in Broadband Commission, 2013b) and the Uruguayan Digital Agenda (see pp. 85-86 in ITU, 2013a) have set specific entry-level fixed-broadband plans that are offered by the main operators in these countries.

[47] Mobile termination rates are regulated in more than 120 countries. Source: ITU Tariff Policies Database 2013 (ICTEye, http://www.itu.int/net4/ITU-D/icteye).

[48] For a detailed description of the ITU ICT Regulatory Tracker, see www.itu.int/tracker.

[49] The EU *acquis* is the body of rights and obligations that is binding on all the EU member states, and also a reference for neighbouring countries. For more details, see: http://ec.europa.eu/enlargement/policy/glossary/terms/acquis_en.htm.

[50] The mean HHI for fixed broadband is calculated as the simple average of the HHI of 139 economies for which price and market share data were available. This includes 95 economies from the developing world and 44 from the developed world.

[51] The mean value of clusters 1 to 3 of the Regulatory Tracker is calculated as the simple average of the scores of 142 economies for which price and market share data were available for 2013. This includes 99 economies from the developing world and 43 from the developed world.

[52] http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/bestpractices.aspx.

[53] The Regulatory Tracker quantifies these aspects of the regulatory framework through the indicators "Separate telecom/ICT regulator", "Separate telecom/ICT regulator", "Enforcement power", "Sanctions or penalties imposed by regulator" and "Dispute resolution mechanism". Each indicator has a weight of 2, so they account for 10 points out of a maximum of 72 for the sum of clusters 1 to 3 of the Regulatory Tracker. To quantify the effects of this on fixed-broadband prices, a regulatory value of 36 (half the maximum) has been taken as a reference to test how the addition of these 10 points would correlate with prices.

[54] This was, for instance, the case of Omantel, which doubled the speeds of Home Broadband customers at no extra cost in March 2014, see: http://www.omantel.om/OmanWebLib/MediaCenter/Press Release.aspx.

[55] The mean HHI for mobile cellular is calculated as the simple average of the HHI of 140 economies for which price and market share data were available. This includes 96 economies from the developing world and 44 from the developed world.

[56] The coefficient of variation of fixed-broadband prices is 1.7, compared with 0.6 for mobile-cellular prices. This means that the dispersion of fixed-broadband prices (as measured by the standard deviation) is of ± 170 per cent around the mean, whereas dispersion in mobile-cellular prices is of ± 60 per cent around the mean.

Chapter 5. The role of big data for ICT monitoring and for development

5.1 Introduction

One of the key challenges in measuring the information society has been the lack of up-to-date and reliable data, in particular from developing countries. The information and communication technologies (ICT) sector is evolving rapidly, as are the types of service and application that are driving the information society, all of which makes identifying and tracking new trends even more challenging. As the key global source for internationally comparable ICT statistics, ITU is continuously working to improve the availability and quality of those statistics and identify new data sources. In this context, the emergence of big data holds great promise, and there is an opportunity to explore their use in order to complement the existing, but often limited, ICT data.

There is no unique definition of the relatively new phenomenon known as big data. At the most basic level it is understood as being data sets whose volume, velocity or variety is very high compared to the kinds of datasets that have traditionally been used. The emergence of big data is closely linked to advances in ICTs. In today's hyper-connected digital world, people and things leave digital footprints in many different forms and through ever-increasing data flows originating from, among other things, commercial transactions, private and public records that companies and governments collect and store about their clients and citizens, user-generated online content such as photos, videos, tweets and other messages, but also traces left by the Internet of Things (IoT), i.e. by those uniquely identifiable objects that can be tracked.

Big data have great potential to help produce new and insightful information, and there is a growing debate on how businesses, governments and citizens can maximize the benefits of big data. Although it was the private sector that first used big data to enhance efficiency and increase revenues, the practice has expanded to the global statistical community. The United Nations Statistical Commission (UNSC) and national statistical organizations (NSOs) are looking into ways of using big data sources to complement official statistics and better meet their objectives for providing timely and accurate evidence for policy-making.[1]

So far, there is limited evidence as to the value added by big data in the context of monitoring of the information society, and there is a need to explore its potential as a new data source. While existing data can provide a relatively accurate picture of the spread of telecommunication networks and services, there are significant data gaps when it comes to understanding the development of the information society. Relatively little information, for example, is available on the demand side. While an increasing number of countries currently collect data on the individual use of ICTs, many developing countries do not produce such information (collected through household surveys or national population and housing censuses) on a regular basis. Consequently, not enough data are available about the types of activity that the Internet is used for, and little is known about the Internet user in terms of age, gender, educational or income level, and so on.

In other areas, such as education, health or public services, even fewer data are available to show developments over time and enable informed policy decisions. The recently published *Final WSIS Targets Review* report (Partnership, 2014), which attempts to assess developments in the information society between 2003 and 2013/14, shows that little information is available to track progress over time. It is obvious that greater efforts must be made to overcome the lack of reliable, timely and relevant statistics on the information society, and that big data have the potential to help realize those efforts.

In addition to the data produced and held by telecommunication operators, the broader ICT sector, which includes not just telecommunication companies but also over-the-top (OTT) service providers such as Google, Twitter, Facebook, WhatsApp, Netflix, Amazon and many others, captures a wide array of behavioural data. Together, these data sources hold great promise for ICT monitoring, and this chapter will explore the potential of today's hyper-connected digital world to expand on existing access and infrastructure indicators and move towards indicators on use, quality and equality of use.

At the same time, there is a growing debate on the role and potential of big data when it comes to providing new insights for broader social and economic development. Big data are already being leveraged to understand socio-economic well-being, forecast unemployment and analyse societal ties. Big data from the ICT industry play a particularly important role because they are the only stream of big data with global socio-economic coverage. In particular, mobile telephone access is quasi-ubiquitous, and ITU estimates that by the end of 2014 the number of global mobile subscriptions will be approaching 7 billion. At the same time, almost 3 billion people – 40 per cent of the world's population – will be using the Internet. In recent years, moreover, the strongest growth in telecommunication access and use has been recorded in the developing economies, where ICT penetration levels have increased and where big data hold great promise for development. However, while there are a growing number of research collaborations and promising proof-of-concept studies, no significant project has yet been brought to a replicable scale in the development sphere. Future efforts will have to overcome a number of barriers, including the development of models to protect user privacy while at the same time allowing for the extraction of insights that can improve service delivery to low-income populations. To this end, this chapter will contribute to the debate on big data for development, highlight advances, point to some best practices and identify challenges, including in regard to the production and sharing of big data for development.

The chapter will first (in Section 5.2) describe some of the current big data trends and definitions, highlight the technological developments that have facilitated the emergence of big data, and identify the main sources and uses of big data, including the use of big data for development and ICT monitoring. Section 5.3 will examine the range and type of data that telecommunication companies, in particular mobile-cellular operators, produce, and how those data are currently being used to track ICT developments and improve their business. Section 5.4 looks at the ways in which telecom big data may be used to complement official ICT statistics and assist in the provision of new evidence for a host of policy domains, while Section 5.5 discusses the challenges of leveraging big data for ICT monitoring and broader development, including in terms of standardization and privacy. It will also make some recommendations for mainstreaming and fully exploiting telecom big data for monitoring and for social and economic development, in particular with regard to the different stakeholders involved in the area of big data from the ICT industry.

5.2 Big data sources, trends and analytics

With the origins of the term "big data" being shared between academic circles, industry and the media, the term itself is amorphous, with no single definition (Ward and Barker, 2013). At the most basic level of understanding, it usually refers to large and complex datasets, and reflects advances in technology that make it possible to capture, store and process increasing amounts of data from different data sources. Indeed, one of the key trends fostering the emergence of big data is the massive "datafication" and digitization, including of human activity, into digital "breadcrumbs" or "footprints".

In an increasingly digitized world, big data are generated in digital form from a number of sources. They include administrative records (for example, bank or electronic medical records), commercial transactions between two entities (such as online purchases or credit card transactions), sensors and tracking devices (for example, mobile phones and GPS devices), and activities carried out by users on the Internet (including searches and social media content) (Table 5.1).

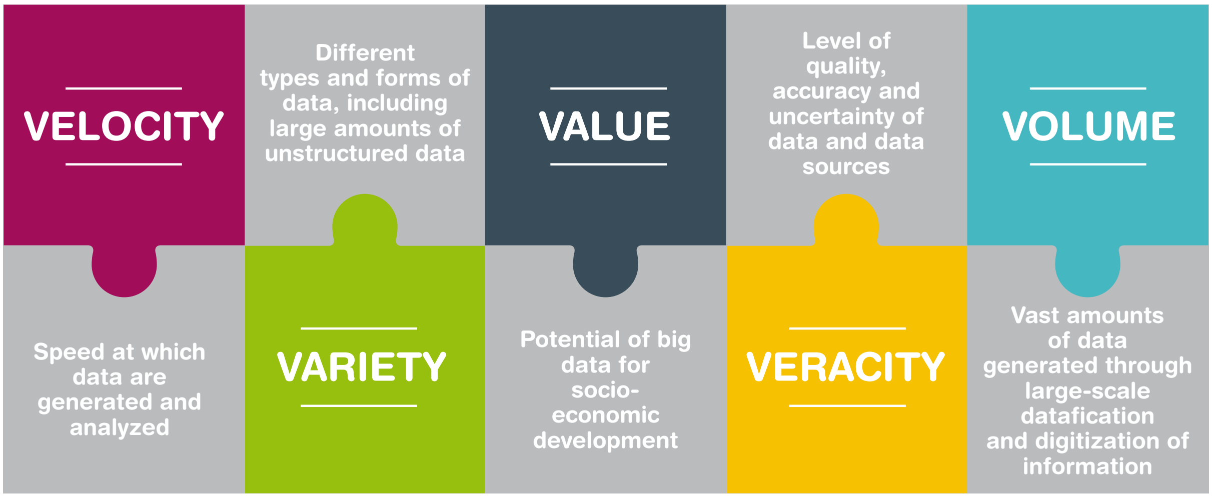
Big data is not just about the volume of the data. One of the earliest definitions, introduced by the Gartner consultancy firm, describes big data characteristics such as velocity and variety, in addition to volume (Laney, 2001). "Velocity" refers to the speed at which data are generated, assessed and analysed, while the

Table 5.1: Sources of big data

Sources	Some examples
Administrative data	• Electronic medical records • Insurance records • Tax records
Commercial transactions	• Bank transactions (inter-bank as well as personal) • Credit card transactions • Supermarket purchases • Online purchases
Sensors and tracking devices	• Road and traffic sensors • Climate sensors • Equipment and infrastructure sensors • Mobile phones • Satellite/GPS devices
Online activities/social media	• Online search activities • Online page views • Blogs and posts and other authored and unauthored online content and social media activities • Audio/images/videos

Source: ITU, adapted from UNSC (2013).

Figure 5.1: The five Vs of big data



Source: ITU.

term "variety" encompasses the fact that data can exist as different media (text, audio and video) and come in different formats (structured and unstructured). The three-Vs definition has caught on and been expanded upon. A fourth V – veracity – was introduced to capture aspects relating to data quality and provenance, and the uncertainty that may exist in their analysis (IBM, 2013). A fifth V – value – is included by some to acknowledge the potentially high socio-economic value that may be generated by big data (Jones, 2012) (Figure 5.1).

Included within the scope of big data is the category of transaction-generated data (TGD),[2] also sometimes described as "data exhaust" or "trace data". These are digital records or traces that have been generated as by-products of doing things (such as processing payments, making a phone call and so on) that leave behind bits of information. The value of this subset of big data is that it is directly connected to human behaviour and its accuracy is generally high. Most of the data captured by telecommunication companies can be classified as TGD.

As is often the case with technological innovation, it is the private sector that has been at the forefront of extracting value from this data deluge. Encouraged by promising results but also reduced budgets, the public sector is turning towards big data to improve its service delivery and increase operational efficiency. In addition, there are uses for big data in broader development and monitoring, and there is an increasing focus on big data's role in producing timely (even real-time) information, as well as new insights that can be used to drive social and economic well-being.

Big data uses by the private and public sectors

Marketing professionals, whose constant aim is to understand their customers, are now increasingly shifting from conventional methods, such as surveys, to the extraction of customer preferences from the analysis of big data. Walmart, the world's biggest retailer, has been one of the largest and earliest users of big data. In 2004, it discovered that the snack food known as Pop Tarts was heavily purchased by United States citizens preparing for serious weather events such as hurricanes. The correlation analysis revealed a behaviour associated with a specific condition that then led Walmart to improve its production chain – in this case, by increasing the supply of Pop Tarts to areas likely to be affected by a disaster. Walmart has also made use of predictive analytics, which uses personal information and purchasing patterns to extrapolate to a likely future behaviour, and to better target and address customer needs. Together, large-scale automated correlation analysis and predictive analytics are two of the key techniques that have helped unleash the value of big data.

Nor is the private sector's use of big data techniques restricted solely to market research. Companies and whole industries (healthcare, energy and utilities, transport, etc.) are using such techniques to optimize supply chains and production (see Box 5.1 for an example from the energy industry). New value is extracted by being able to link new information on customers to the production process in a way that enables companies to tailor and segment their products at low cost. Firms that are highly proficient in their use of data-driven decision making have been found to have productivity levels up to 6 per cent higher than firms making minimal to no use of data for decision-making (Brynjolfsson, Hitt and Kim, 2011). Significantly, industries now have the ability to conduct controlled experiments at a scale and with a speed that are unprecedented. Google, for example, is running about a thousand experiments at any given point in time (Varian, 2013a). Telecom network operators make extensive use of such techniques when rolling out new services, among other things for the purpose of pricing. Telecom operators also use big data techniques to understand and control churn, optimize their management of customer relations and manage their network quality and performance.

These fundamental shifts in data exploitation to generate new socio-economic value, coupled with the simultaneous emergence of new rich data sources that can potentially be linked together and analysed with ease, have also sparked the interest of governments, researchers and development agencies. Encouraged by the potential of big data to produce new insights and slimmer budgets, governments (at all levels) are now looking to exploit big data and increase the application of data analytics to a range of activities, including monitoring and improvement of tax compliance and revenues, crime detection and prediction, and improvement of public service delivery (Giles, 2012; Lazer et al., 2009).

To this end, governments, in addition to the data they collect and generate themselves,

Box 5.1: How big data saves energy – Vestas Wind Systems improves turbine performance

Vestas, a global energy company dedicated to wind energy, with installations in over 70 countries, has used big data platforms to improve the modelling of wind energy production and identify the optimal placement for turbines.

Wind turbines represent a major investment and have a typical lifespan of 20 to 30 years. To determine the optimal placement for a turbine, a large number of location-dependent factors must be considered, including temperature, precipitation, wind velocity, humidity and atmospheric pressure. By using big data techniques based on a large set of factors and an extended set of structured and unstructured data, Vestas was able to significantly improve customer turbine location models and optimize turbine performance.

Big data have enabled the creation of a new information environment and allowed the company to manage and analyse weather and location data in ways that were previously not possible. These new insights have led to improved decisions relating not only to wind turbine placement and operation, but also to more accurate power-production forecasts, not to mention greater business-case certainty, speedier results, and increased predictability and reliability. This reduces the cost to customers per kilowatt-hour produced, while increasing the accuracy of the customer's return-on-investment estimates.

Source: ITU, based on IBM (2012).

complement their official statistics by leveraging data from new sources, including crowd-sourced data generated by the public. In the United States, for example, Boston City Hall released the mobile app "Street Bump", which uses a phone's accelerometer to detect potholes while the app user is driving around Boston and notifies City Hall.[3] Some of the richest data sources for enabling governments and development agencies to improve service delivery are actually external. Such external data include those captured and/or collected by the private sector, as well as the digital breadcrumbs left behind by citizens as they go about their daily lives.

According to a recently published White House report, United States government agencies can make use of public and private databases and big data analytics to improve public administration, from land management to the administration of benefits. The Department of the Treasury has set up a "Do Not Pay" portal, which links various databases and identifies ineligible recipients to avoid wrong payments and reduce waste and fraud[4] (The White House, 2014).

Big data for development and ICT monitoring

One of the richest sources of big data is the data captured by the use of ICTs. This broadly includes data captured directly by telecommunication operators as well as by Internet companies and by content providers such as Google, Facebook, Twitter, etc. Big data from the ICT services industry are already helping to produce large-scale development insights of relevance to public policy. Collectively, they can provide rich and potentially real-time insights to a host of policy domains. It should be noted that in some countries and regions the use of big data, including big data from the ICT industry, is subject to national regulation. In the EU, for example, a number of directives require data producers to obtain users' consent before gathering any of their personal data.[5]

One of the best-known examples of leveraging the online population's digital breadcrumbs for development purposes is Google Flu Trends (GFT). Following its launch in 2008, GFT was remarkably accurate in tracking the spread of influenza in the United States, doing so more rapidly than the Centers for Disease Control and Prevention (CDC), with a lag time of only one day as opposed to one week. Although it has since been subject to criticism (see Section 5.5), GFT was held up as an outstanding example of big data in action and of the great potential of big data for broader development and monitoring (Mayer-Schönberger and Cukier, 2013; McAfee and Brynjolfsson, 2012). GFT worked by monitoring health-seeking behaviour expressed through online searches, with the search terms being correlated wherever they related to flu-like symptoms (Ginsberg et al., 2009). This proved to be so successful that it spawned similar efforts focusing on the use of search-engine data to understand dengue fever outbreaks,[6] monitor prescription drug use (Simmering, Polgreen and Polgreen, 2014), predict unemployment claims in the United States (Choi and Varian, 2009) and Germany (Askitas and Zimmermann, 2009), and forecast near-term values for economic indicators such as car and home sales and international visitor statistics (Choi and Varian, 2012).

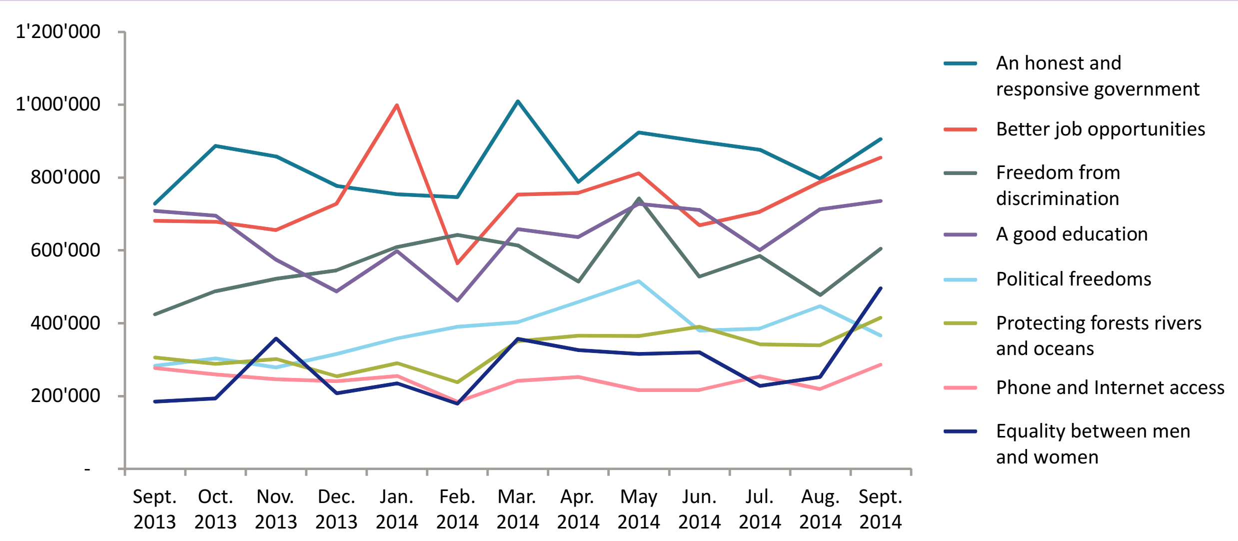
The Internet has also been a rich source of big data beyond the realm of user search terms. Online job-posting data are being used to supplement traditional labour statistics in the United States[7] and other countries. In another effort, an academic project at MIT known as the Billion Prices Project collects high-frequency price data from hundreds of online retailers.[8] The data are then used by researchers to understand a whole host of macroeconomic questions relating to, among other things, pricing behaviour, daily inflation and asset-price movements. This has the advantage of providing near real-time inflation statistics that are traditionally published monthly.

Box 5.2: How Twitter helps understand key post-2015 development concerns

As the process of formulating the post-2015 development agenda continues, UN Global Pulse and the Millennium Campaign are using big data and visual analytics to identify the most pressing development topics that people around the world are concerned about and consider a priority.

Their interactive visualization tool shows the 16 topics that people have tweeted the most about. Users can select a country to see the number of tweets generated by its Twitter users in regard to the highlighted topic, as compared to tweets about all the other topics. This information provides insight as to which of the various post-2015 issues are being talked about the most. In September 2014, at the global ("all countries") level, *An honest and responsive government* was the key priority, followed by *Better job opportunities* and *Freedom from discrimination*. Also highly ranked, in 7th position, was phone and Internet access. By clicking on any of the data points in the chart, the application provides information on the number of tweets (per month) for each topic. It also lists the top words that those tweets contained.

Chart Box 5.2: Using Twitter to visualize trends in global development topics



Source: UN Global Pulse, see: http://post2015.unglobalpulse.net/#.

UN Global Pulse, a UN initiative to use big data for sustainable development and humanitarian action, has been mining Twitter data from Indonesia (where Twitter usage is high)[9] to understand food price crises. Global Pulse was able to identify a consistent pattern among specific food-related tweets and the daily food price index. In fact, it was able to use predictive analytics on the Twitter data to forecast the consumer price index several weeks in advance (Byrne, 2013). As discussions on the post-2015 development agenda continue, UN Global Pulse is also using Twitter data to understand and compare the relevance of different development topics among countries (Box 5.2).

In fact, the ICT sector is itself using the Internet as a source of big data for monitoring purposes. Regulators and others are now using the Internet to crowd-source quality of service (QoS) data on broadband quality. For example, the United States Federal Communications Commission (FCC) has released mobile apps that enable consumers to check their broadband quality. The test results, which are anonymous, are then used by FCC to understand and address coverage and quality issues in different areas.[10]

Mobile data

Despite the rapid growth in Internet access, 60 per cent of the world's population is still not using the Internet. Household Internet penetration in developing economies is expected to reach 31 per cent by the end of 2014, as against almost 80 per cent in developed economies. In addition, as Internet penetration rates remain limited, Internet users are not (yet) representative of the population at large. For example, Internet users tend to be younger, relatively well educated, with men still more likely to be online than women, especially in developing countries[11] (ITU, 2013).

Depending on the source of Internet data, results may also be more or less biased. A 2013 study into the characteristics and behaviour of Facebook users, for example, revealed that while in many ways Facebook users have real-life behaviour and characteristics, in many ways the social network fails as a representation of society. On the one hand, for example, the American Facebook user's relationship status of "married" on Facebook is very similar to real life (census) data on the average age when American people get married. On the other hand, however, the average American Facebook user is much younger than the average citizen.[12] This is just one example, but it highlights the need to take account of particular characteristics and the limitations of producing representative results when extracting information from online users' behaviour.

Given the popularity of mobile-cellular services, non-Internet-related mobile-network big data seems to have the widest socioeconomic coverage in the near term, and the greatest potential to produce relatively representative information globally, particularly in developing countries. By the end of 2014, the number of mobile-cellular subscriptions is expected to be nearing 7 billion, and the number of mobile-cellular subscriptions per 100 inhabitants is expected to reach 90 per cent. Mobile data are already being utilized for research and policy-making, not only in developed but also in developing economies.

There are various examples of how mobile phone records have been used to identify socio-economic patterns and migration patterns, describe local, national and international societal ties, and forecast economic developments.[13] Data are also being used to improve responsiveness in the event of natural disasters or disease outbreaks. Lu, Bengtsson and Holme (2012) used mobile call records to study the population displacements following Haiti's 2010 earthquake, with a view to using such methods to improve the effectiveness of humanitarian relief operations immediately after a disaster. Call records have also been merged with epidemiological data to understand the spread of malaria in Kenya (Pindolia et al., 2012; Wesolowski et al., 2012a), and of cholera in Haiti after the 2010 earthquake (Bengtsson, Lu, Thorson, Garfield and von Schreeb, 2011) and in Côte d'Ivoire (Azman, Urquhart, Zaitchik and Lessler, 2013). Mobile network big data have been utilized to great effect in the area of transportation, helping to measure and model people's movements (even in real time) and understand traffic flows (Wu et al., 2013).

It is evident from the examples given that big data from the ICT sector, and especially those available to telecommunication operators, have wide applicability for informing multiple public policy domains. Leveraging such data to complement official statistics and facilitate broader development will enable governments as well as development agencies to better serve their citizens and beneficiaries. Less use has thus far been made of telecommunication big data with a view to understanding its potential for producing additional information and statistics on the information society. In assessing that potential, including the potential for providing complementary information on the development of the information society, it is first important to better understand the type of data that can be made available.

5.3 Telecommunication data and their potential for big data analytics

Fixed and mobile telecommunication network operators, including Internet service providers (ISPs), are an important source of data and for the purpose of this chapter, all forms of telecommunication big data (either volume, velocity or variety) are being considered. Most telecommunication data can be considered as TGD,[14] that is, the result of an action undertaken (such as making a call, sending an SMS, accessing the Internet or recharging a prepaid card).

Since the service with the widest coverage and greatest uptake and popularity is the mobile-cellular service, data from mobile operators have the greatest potential to produce representative results and reveal developmental insights on the population, including in developing countries and, increasingly, low-income areas. Not surprisingly, the big data for development initiatives (outlined in Section 2.2) have mainly drawn on mobile-network big data rather than on those from fixed-telephone operators or ISPs. Figure 5.2 illustrates some of the similarities and differences in the type of information that mobile-network operators, as opposed to fixed-telephone operators and ISPs, produce, and shows some of the additional insights, in particular in terms of the location and mobility information that mobile networks and services generate.

Telecommunication data

The mobile telecommunication data that operators possess can be classified into different types, depending on the nature of the information they produce. They include traffic data, service access detail records, location and movement data, device characteristics, customer details and tariff data. For a more detailed overview of these types of data, see Chapter 5 Annex.

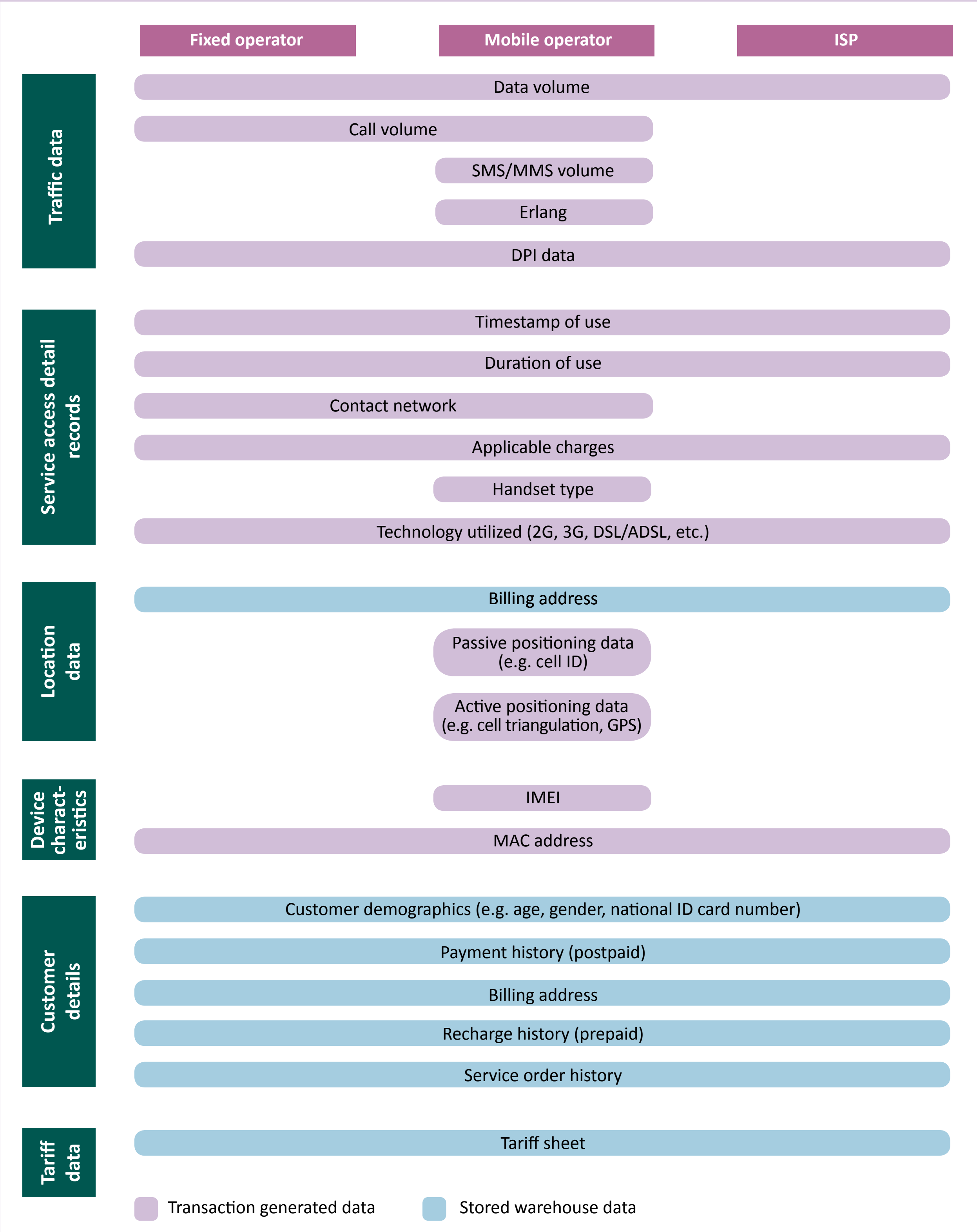
To collect **traffic data**, operators use a range of metrics to understand and manage the traffic flowing through their networks, including the measurement of Internet data volumes, call, SMS and MMS volumes, and value-added service (VAS) volumes. Internet service providers can also use deep packet inspection (DPI),[15] which is a special process for scanning data packages transiting the network.

Service access detail records, including call detail records (CDRs), are collected by operators whenever clients use a service. They are used to manage the infrastructure and for billing purposes, and include information on the time and duration of services used and the technology used, for example, for the mobile network (2G, 3G, etc.). These data are potentially also very useful for building a rich profile of customers, as outlined in this section.

Mobile networks capture a range of **movement and location variables** to identify user location and movement patterns. The degree of accuracy of this information depends on a number of factors, including the network used and device generation, and can be broadly classified into two different types: passive and active positioning data, with the latter providing more detailed and precise location information.

Since mobile user devices used to access mobile telecommunication services come with an international mobile station equipment identity (IMEI) number, operators can identify some **device characteristics**, including the handset make and model and type of technology (2G, 3G, LTE) employed. Mobile network operators can use the IMEI number to identify the specific mobile handset being used by a subscriber, which in turn can provide some insight as to that

Figure 5.2: An overview of telecom network data



Source: ITU, adapted from Naef et al. (2014).

Box 5.3: How mobile operators currently use data to track service uptake, business performance and revenues

Operators use their TGD to monitor the uptake and penetration of particular services, identify market shares and monitor their business performance, as well as for reporting purposes. They can also track the extent to which different technologies are used, not just in terms of handset capabilities but also actual usage, enabling them, for example, to determine the number of active mobile-cellular and active mobile-broadband subscriptions.

On the basis of the detailed service-usage data collected, telecommunication operators can produce a range of detailed indicators relating to service consumption. For each customer, it is possible to determine the minutes of use (MoU), number of originating and terminating calls, SMS and MMS usage, data upload volumes, data download volumes, level of use of different VAS, and level of use of different OTT services. These data can be reported as averages (over time or for different categories of user), as well as at various levels of aggregation (again over time or for different categories of user). These measures are often key performance indicators (KPIs), tracked and used in particular by operators, but also by regulators and at the international level.

Finally, service consumption data are used to produce revenue data and projections at various levels of disaggregation or aggregation. For example, the average revenue per user (ARPU) is a KPI for operators, which identify their most important customers on the basis of the revenue they generate for the company. Similarly, revenue projections are made not just at the level of a particular service,[16] but also to identify the most important network elements. For example, mobile operators collect indicators on the revenue being generated at the base station level, often in real time. Collectively, these revenue-based metrics can also be used by the operator to ensure a higher QoS and higher bandwidth at those locations generating the most revenue. Mobile operators will, for instance, often associate revenue data with resource allocation to ensure that QoS at the base stations used by their premium customers is maintained at the highest possible level.

Source: ITU.

subscriber's purchasing power (see below for more details).

In addition, telecommunication operators hold various **customer details** that were captured during the customer registration process. These can include the customer's name, age, gender, billing address and, in some cases, national identity card number. Customer details may also include a history of the services accessed, service option preferences as well as other details (as referred to in Chapter 5 Annex).

Finally, operators maintain **tariff data** in the form of billing records for their current and past services, from which information on a customer's usage patterns and preferences can be extracted.

The information outlined above is used at the aggregate level to derive a range of indicators to provide operators with information on the uptake of different services and on their business performance and revenues (Box 5.3). The information is also an important tool for regulatory authorities and policy-makers as they evaluate existing policies and establish new ones. At the international level, organizations such as ITU, but also consultancy firms and others, use aggregated revenue data to track and benchmark countries' ICT developments, monitor the evolution of the information society and identify digital divides.

The telecom industry's use of big data

Telecommunication companies are actively seeking to intensify their use of big data analytics in order to improve existing services and create new ones. For operators, big data open up opportunities for better understanding of their customers, which in turn leads to improved sales and marketing opportunities. At the same time, big data can help optimize network operations and create new revenue streams and business lines, for example when selling data.

Customer profiling

Telecom operators capture a range of behavioural data about their customers.

Customer profiles include details about customers' mobility patterns, social networks and consumption preferences. Collectively, these digital breadcrumbs enable operators to profile and segment their customers based on a variety of metrics (Figure 5.3). Depending on the country or region, there may be different privacy and data regulations governing the manner in which operators may keep and/or use such data. This being the case, the extent to which behavioural profiling is used by operators may vary greatly.

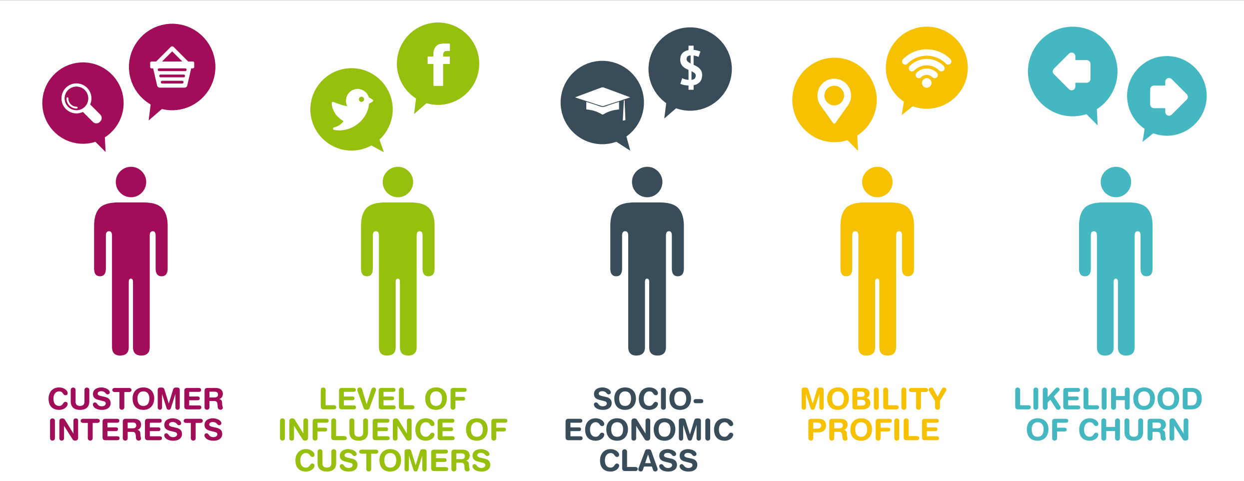
- Customer interests: these can be captured, or in some cases inferred, on the basis of usage levels (time spent and/or volume) for different VAS and OTT services. DPI can also be used to categorize interests based on sites visited (as opposed to content accessed). Sophisticated clickstream analyses from DPI data[17] can also generate more finely-grained interest classifications.

- Socio-economic class: While customer details will often enable operators to classify their customers' socio-economic status, such details are not always very reliable. Big data, on the other hand, can help to enhance that classification by enabling analysis of the levels of consumption of different services, including on the basis of spending (often in relation to other services), types of device used, frequency of change of handset, and so on.

- Likelihood of churn: The churn rate is a measure of the number of customers leaving the network or a particular service offered by an operator. Understanding churn is crucial to operators for obvious reasons. Big data techniques can help operators understand churn better by enabling them to model the likelihood of customers leaving the network (or opting out of a given service) by focusing on the customer's existing service usage behaviour.

- Level of influence of customers: Operators are keen to leverage service and technology diffusion among their subscribers with a view to marketing additional, customized services. This often calls for an understanding of the level of influence of each subscriber's social networks, both on-network (i.e. within the same operator) as well as off-network (i.e.

Figure 5.3: Customer profiling using telecom big data



Source: ITU.

in competitor networks). By identifying a large number of off-net users in a customer's network, operators may target the subscriber and/or the off-net users with promotions and incentives aimed at converting off-net connections into on-net users.

- Mobility profile: Mobile operators accord a high priority to identifying the locations most frequented by their customers, in order not only to ensure a high QoS in those areas, but also, more recently, to build mobility profiles of their customers that can be leveraged for location-based services.

Sophisticated customer profiling enables operators to personalize and market new services more effectively. For example, by understanding their customers' relationships to their social networks (and their relative importance within them), operators are able to model the diffusion of services and create targeted promotions. Furthermore, social network insights can be used by an operator to market its services to the off-network contacts that are connected to its customers, or to reduce churn rates. In the Republic of Korea, for example, SK Planet, a subsidiary of SK Telecom, uses big data to help its parent company to cut churn and generate new revenue, and has used data mining to achieve a fourfold improvement in churn forecasting. The operator found that customers planning to quit their current package tend to use specific search phrases, such as "data plan" or "operator benefits", at least three to seven days before taking action. When operators suspect that customers may be looking elsewhere, they may try to keep them by providing them with a tailored offer.[18]

Network planning and management

By analysing their networks in real time, operators can optimize routing and ensure QoS. The use of real-time DPI enables them to optimize traffic routes and details of traffic volumes, including the geospatial distribution of demand, and to plan and manage their networks more effectively through optimal resource allocation. By utilizing geospatial information about their most active customers and high-revenue regions, operators can adapt their resource allocation to ensure that more resources are channelled into active locations. This is an area of great significance to operators as they seek to understand the demands placed on their networks by the use of popular OTT services.

New business lines

To increase revenue streams, operators may also seek to monetize the data they hold. The simplest way of doing this is to sell (anonymized) data to third parties. The customer insights obtained through the analysis of usage data can also help create new business lines, either through innovation (e.g. new types of VAS) or by partnering with other businesses, including credit-scoring and related financial services. One example is the US-based big data startup Cignifi,[19] which obtains data from mobile operators and financial institutions to build credit profiles and evaluate customer creditworthiness (see Box 5.8). Cross-promotions with brick-and-mortar businesses are a potentially high-growth area in which the detailed mobility profiles available to operators are leveraged.

5.4 Big data from mobile telecommunications for development and for better monitoring

In 2013, the United Nations High-Level Panel of Eminent Persons on the Post-2015 Development Agenda called for a "data revolution" that draws on existing and new sources of data for the post-2015 development agenda (United Nations, 2013). In March 2014, the forty-fifth session of UNSC, the highest decision-making body for international statistical activities, presented a report on "big data and modernization of statistical systems", and proposed the creation of a big data working group at the global level (UNSC, 2013).[20] Current uses of big data to complement official statistics are still exploratory, but there is a growing interest in this topic, as evidenced by the numerous initiatives being pursued by the United Nations, as well as by others, including the World Bank, OECD, Paris21 and NSOs.

There are many big data sources that can be used to monitor and assess development results. In a world where mobile telephony is increasingly ubiquitous, it is not surprising that mobile telecommunication big data have unique potential as a new data source, with high mobile-cellular penetration levels and the increasing use of mobile phones, even among the poorest and most deprived, making them particularly valuable by comparison with other types of telecommunication data. Indeed, when referring to the data revolution, the United Nations High-Level Panel cited the example of "mobile technology and other advances to enable real-time monitoring of development results".

This section will present some of the existing (and growing) evidence for the role of mobile big data in achieving development goals in various policy areas, including disaster management and sustainable and economic development.

In addition to their use for development, telecommunication big data have potential as a source to enable monitoring of the information society, although they have yet to assume a critical role in complementing the official ICT statistics that are collected and used for that purpose. As the lead agency on global telecommunication and ICT statistics, however, ITU is exploring the potential of big data to complement its existing, and often limited, set of ICT statistics. This section presents a first attempt to help identify some of the areas in which mobile telecommunication big data could complement existing ICT indicators to provide a more complete, comprehensive and up-to-date picture of the state of today's information society.

Mobile phone big data for development

Mobile data offer a view of an individual's behaviour in a low-cost, high-resolution, real-time manner. Each time a user interacts with a mobile operator, many details of the interaction are captured, creating a rich dataset relating to the consumer. Topping up airtime, making calls and sending SMSs, downloading applications or using value-added services are all examples of interactions for which the time, location, device, user and other detailed information are captured in the operator's system. From these interactions, information about identity, movement patterns, social relationships, finances and even ambient environmental conditions can be extracted. In addition to the fact that these data are uniquely detailed and tractable, the information captured cannot easily be derived from other sources on such a scale. The fact that the format of the data is relatively similar across different operators and countries creates a huge potential for the global scaling of any application found to have significant benefits. Box 5.4 illustrates the potential of mobile data for development in a number of different areas.

There have been a number of interesting research collaborations and some promising proof-of-concept studies, for example in the areas of disaster management and transportation planning, and for understanding socio-economic developments and societal structures.

Big data for disaster management and syndromic surveillance[21]

Mobility data collected immediately after a disaster can in many cases help emergency responders to locate affected populations and enable relief agencies to direct aid to the right locations (Lu, Bengtsson and Holme, 2012b).

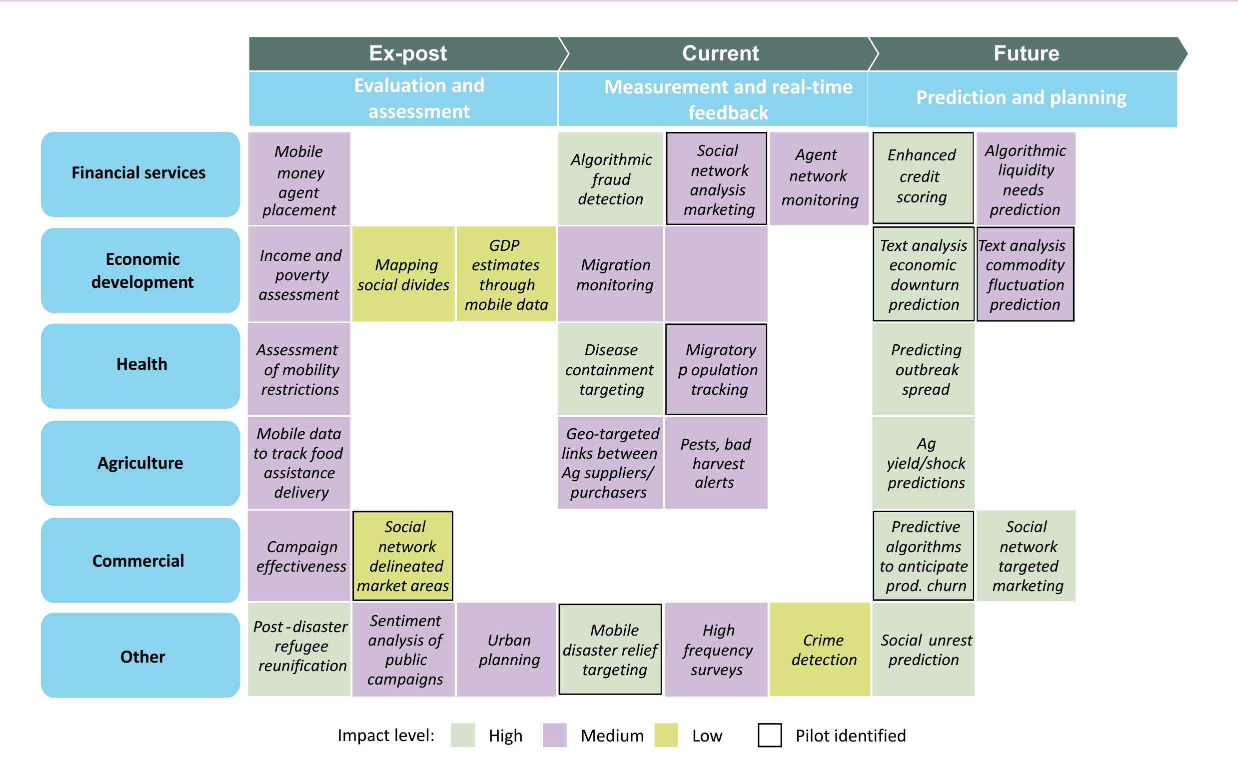
One application of such mobility data is for syndromic surveillance, especially to model the spread of vector-borne[22] and

Box 5.4: Using mobile data for development

A recently published report (Cartesian, 2014) explores the potential of mobile data for development. It points to three primary types of analysis - ex-post evaluation, real-time measurement, and future predictions and planning - in a number of areas (including health, agriculture and economic development), and suggests that *"the more predictive the analytics can be, the higher impact the analysis will have through the ability to anticipate future events or trends"* (Figure Box 5.4).

The report further highlights that while there have been a number of interesting research collaborations and some promising proof-of-concept studies, no significant programme has yet been brought to a replicable scale. Future efforts will have to overcome a number of barriers to scale, including the development of models which protect user privacy while still allowing for the extraction of insights that can serve development purposes, particularly where those in most need, including low-income populations, are concerned.

Figure Box 5.4: Areas of highest potential impact across sectors



Source: Naef et al. (2014).

other communicable diseases. Pioneering research in Kenya combined passive mobile positioning data with malaria prevalence data to identify the source and spread of infections (Wesolowski et al., 2012b). Similar work in Haiti showed how mobile phone data was used to track the spread of cholera after the 2010 earthquake (Bengtsson et al., 2011, see Box 5.5).

The integration of mobility data from mobile networks with geographic information frameworks,[23] supplemented with additional information, shows great potential for tracking the spread of vector-borne and other communicable diseases. This highlights the need to ensure that the response plan implemented after any disaster includes ensuring that any damaged mobile-network infrastructure is repaired as rapidly as possible.

Big data for better transportation planning

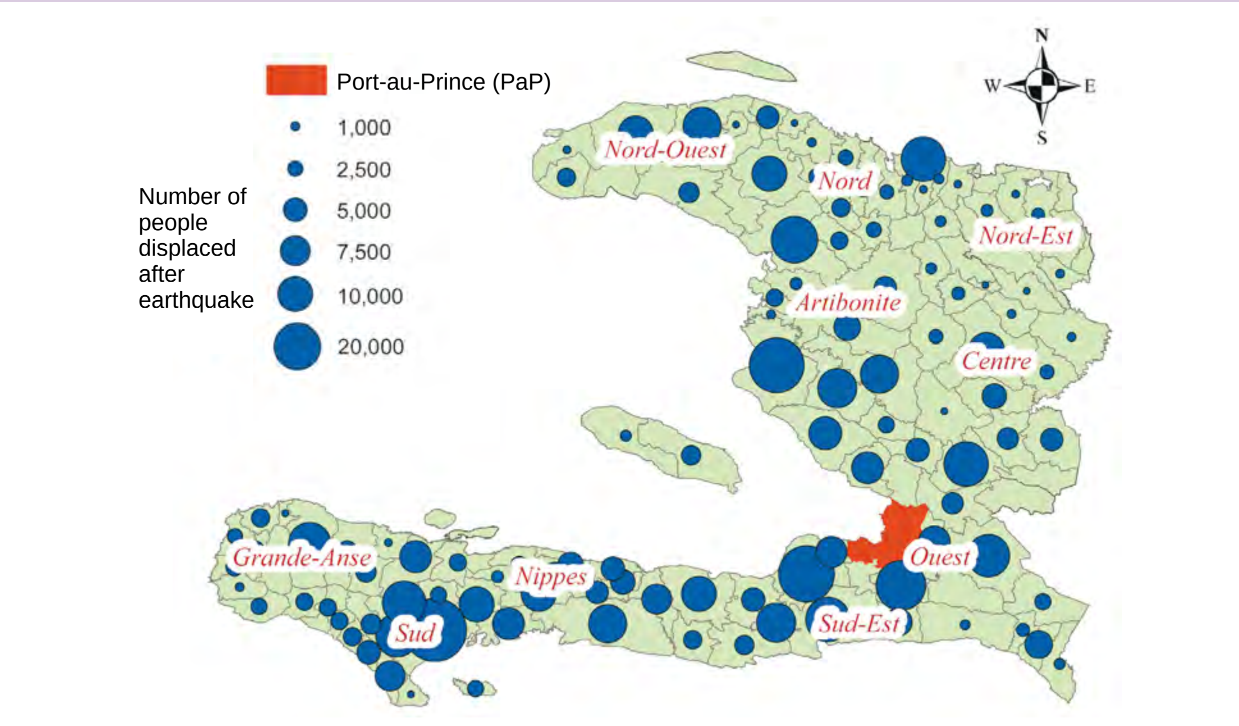
A data-centric approach to transportation management is already a reality in many developed economies. Transportation systems are being fed with sensor data from a multitude of sources such as loop detectors, axle counters, parking occupancy monitors, CCTV, integrated public transport card readers and GPS data derived not only from phones but also from public transport and private vehicles (Amini, Bouillet, Calabrese, Gasparini and Verscheure, 2011).

One advantage of mobile networks is that even the least developed mobile-network infrastructure generates passive positioning data, which, despite its limited spatial accuracy (cell ID), has great potential for transportation planning. For example, IBM researchers used CDR data from mobile operator Orange to map out citizens' travel routes in Abidjan, the largest city in Côte d'Ivoire, and show how data-driven insights could be used to improve the planning and management of transportation services, thereby reducing congestion (Berlingerio et al., 2013). By simply extending one bus route and adding four new ones, overall travel time was reduced by ten per cent. Passive mobile positioning data has also been used for transportation planning and management in Estonia (Ahas and Mark, 2005), and has provided reliable results in Sri Lanka (Lokanathan et al., 2014, see Box 5.6).

Box 5.5: How mobile-network data can track population displacements – an example from the 2010 Haiti earthquake

The Figure below shows the number of people estimated to have been in Port-au-Prince (PaP) on the day of the 2010 Haiti earthquake, but *outside* the capital 19 days later. The circles represent the numbers of people who were displaced. This map was produced on the basis of mobile-network data to show the potential of big data in tracking population movements.

Figure Box 5.5: Tracking mobility through mobile phones



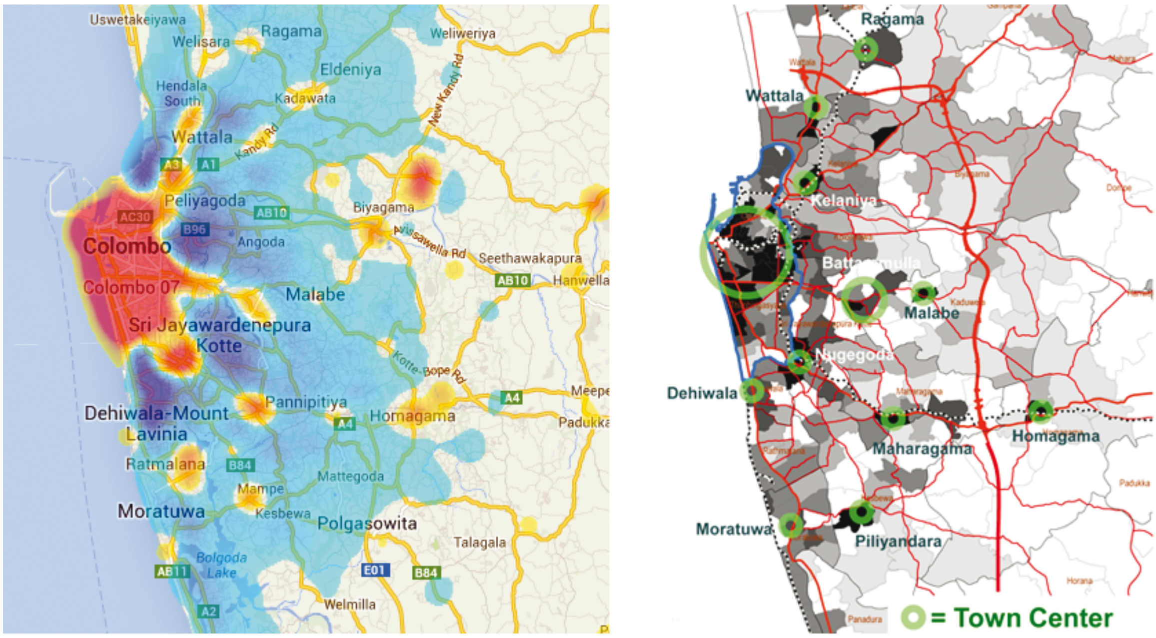
Source: Bengtsson et al. (2011).

Box 5.6: Leveraging mobile-network data for transportation and urban planning in Sri Lanka

Very similar findings between the results of an official household survey assessing mobility patterns (right-hand map) with the results of a big data analysis using mobile-phone data (left-hand map) underscore the merits of big data. The image on the left, based on mobile-phone data, depicts the relative population density in Colombo city and its surrounding regions at 1300 hours on a weekday in 2013, compared to midnight the previous day. While the yellow to red colouring shows areas in which the density has increased relative to midnight, the blue colouring depicts areas in which the density has decreased relative to midnight (the darker the blue, the greater the loss in density). The clear areas are those in which the overall density has not changed. The image reflects the movement of people from the outskirts of the city to its centre during the day.

An almost identical finding is to be seen in the map on the right, which depicts the major transportation transit points identified using a costly survey of 40 000 households to understand mobility patterns.

Figure Box 5.6 : Mobile big data (left) versus official survey data (right)



Source: Lokanathan et al. (2014).

Both passive and active positioning data are used to analyse traffic conditions, particularly in urban areas with higher base-station density. Active positioning data (especially GPS) produce higher precision in location data and are therefore the most useful. Operators may offer such specialized services (based on passive or active location data) either directly, or by providing data to third parties. Mobile network data are less expensive, are in real time and are less time-consuming to produce than survey data, particularly in urban and peri-urban areas where base-station density tends to be high.

In another example, the analysis of mobility flows between two Spanish cities derived from three different data sources – mobile-phone data, geolocated Twitter messages and the census – showed very similar results, and although the representativeness of the Twitter geolocated data was lower than the (real-time) mobile-phone and census data, the degrees of consistency between the population density profiles and mobility patterns detected by means of the three datasets were significant (Lenormand et al, 2014).

Big data for socio-economic analysis

Data from mobile operators can provide insights in the areas of economic development and socio-economic status, often in near real time. Big data techniques can therefore complement official statistics in the intervals between official surveys, which are usually relatively expensive and time-consuming and therefore carried out infrequently. In many cases, insights derived from big data sources may help to fill in the gaps, rather than replace official surveys. It should also be noted that mobile-network big data are one of the few big data sources (and often the only one) in developing economies that contain behavioural information on low-income population groups.

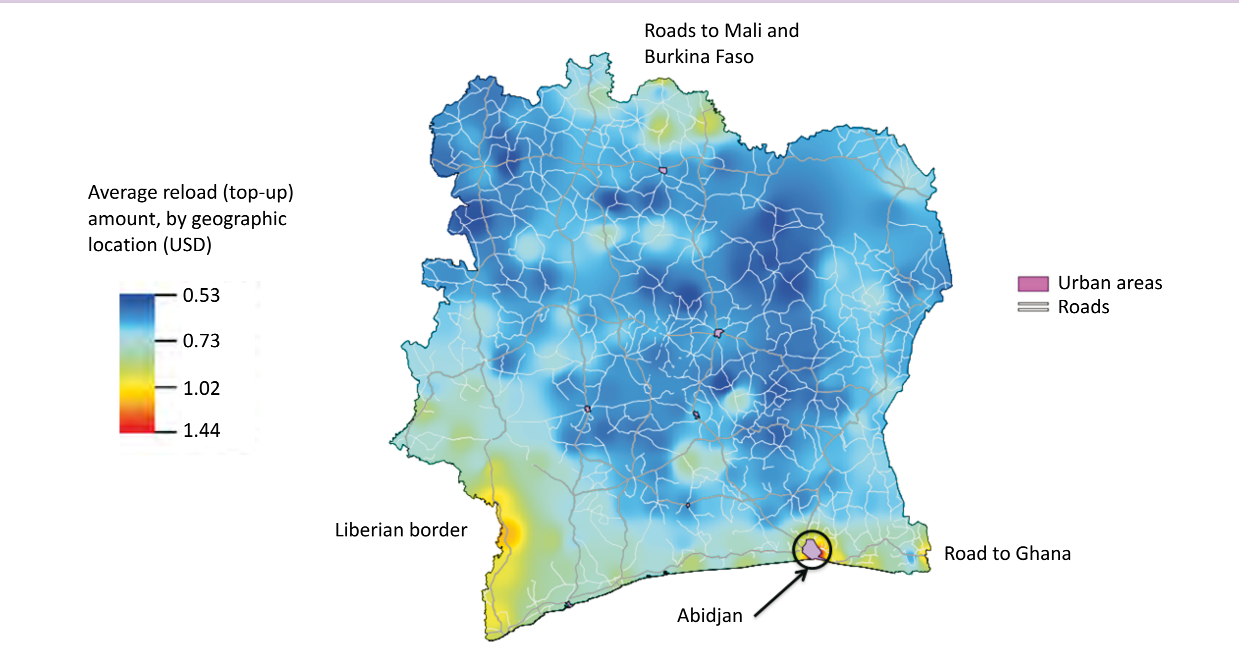
Frias-Martinez et al. (2012) developed a mathematical model to map human mobility variables derived from mobile-network data to people's socio-economic and income levels. The model took into account existing socio-economic and income-related data derived from official household surveys, and the results showed that populations with higher socio-economic levels are more strongly associated with larger mobility ranges than populations from lower socio-economic levels. By extending this method, the study suggested that it was possible to create a model to estimate income levels based on data from mobile-network operators.

Another study, by Gutierrez, Krings and Blondel (2013), used two types of mobile-network data, namely subscriber communication data and airtime credit purchase records, to assess socio-economic and income levels. The authors used airtime purchase records based

Box 5.7: Poverty mapping in Côte d'Ivoire using mobile-network data

In Côte d'Ivoire, researchers used mobile-network data (specifically communication patterns, but also airtime credit purchase records) from Orange to estimate the relative income of individuals, as well as the diversity and inequality of income levels. The research helped to understand socio-economic segregation at a fine-grained level for Côte d'Ivoire, with the following map showing poor areas (in blue) in relation to the areas of high economic activity (yellow to red areas).

Figure Box 5.7: High-and low-income areas in Côte d'Ivoire



Source: Gutierrez et al. (2013).

on the assumption that users who make large purchases are more affluent than those who make multiple smaller purchases, as people with lower incomes will not have enough ready cash to make single purchases of large amounts of airtime credit. They combined this analysis with a study of users' social networks, with two users being considered as connected if they communicated with each other at least once a month. Results showed that people tend to socialize with those who have a similar purchasing power (i.e. a similar income level).

Research suggests that operators have access to potentially valuable information that could help improve poverty mapping (See Box 5.7) and identify sudden events that depress the local economy (i.e. economic shocks). One of the challenges has to do with operator sensitivity regarding revenue data and the difficulty this poses for outside parties wishing to obtain such data.

The use of mobile-operator TGD can also foster financial inclusion by facilitating the provision of credit to the unbanked. In 2012, the Consultative Group to Assist the Poor (CGAP) and GSM Association (GSMA) estimated that close to 2 billion people had a mobile phone but no bank account. After analysing mobile consumption variables, CGAP suggested that it was possible to identify the creditworthiness of the unbanked (Kumar and Muhota, 2012). For example, people who purchase airtime frequently and in a consistent manner demonstrate income predictability and an ability to plan ahead, which may be a positive indication of their ability to repay a loan. Conversely, people with prepaid accounts that are inactive or which regularly run out of credit would perhaps not repay a loan in a timely manner. A compelling example of how mobile big data can be used for the unbanked is Cignifi, a big data startup that uses the mobile phone records of poor people to assess their creditworthiness when they apply for a loan (Box 5.8).

Big data for understanding societal structures

Social-network studies relying on self-reporting relational data typically involve both a limited number of people and limited number of time points (usually one). As a result, social-network analysis has generally been confined to the examination of small population groups through a small number of snapshots of interaction patterns. By examining social communication patterns based on telecommunication data, it has become possible to obtain insights into societal structures on a scale that was previously unavailable. Mobile-phone records

Box 5.8: Using mobile-phone data to track the creditworthiness of the unbanked

Cignifi, a big data startup, has developed an analytic platform to provide credit and marketing scores for consumers, based on their mobile-phone data. The Cignifi business model is founded on the idea that "Mobile phone usage is not random – it is highly predictive of an individual consumer's lifestyle and risk".

Based on the behavioural analysis of each mobile-phone user – phone calls, text messages, data usage and, extrapolating from these, lifestyles – the company identifies patterns and uses them to generate individual credit risk profiles. This information could help many of the world's unbanked to have access to insurance, credit cards and loans. Scores are dynamic and respond to changes in customer activity as the data are refreshed, usually every two weeks. In addition to updating a person's creditworthiness, the system also helps to identify a customer's appetite for different products and inclination to churn.

The credit-scoring model is being tested in Tanzania and Brazil. In Brazil, Cignifi constructed 50 behavioural variables from 2.3 million prepaid mobile subscriptions and verified the findings from the model against historical lending data from approximately 40 000 borrowers using the mobile operator Oi's lending business, Oi Paggo. The test showed that the model was an accurate predictor of default, with the score proving to be a useful complement to, although not a replacement for, the credit underwriting effort. Experian Microanalytics ran a similar trial in the Philippines (Kumar and Muhota, 2012).

Source: ITU, based on Cignifi.

have been used to study the geographic dispersion and cohesion of societies in relation to socio-economic boundaries by examining the geospatial distribution of societal ties in both developed and developing economies (Sobolevsky et al., 2013).

However, telecommunication data are also revolutionizing the study of societal structures at the micro level. Eagle et al. (2009) show that it is possible to assess friendship using data from mobile-network operators, and that the accuracy is high when compared with self-reported data. Leveraging these behavioural signatures to obtain an accurate characterization of relationships in the absence of survey data could also enable the quantification and prediction of macro and micro social-network structures that have thus far been unobservable.

Big data to monitor the information society

There is a case to be made for analysing data captured by telecommunication operators in the interests of improving the current range of indicators used for monitoring the information society. An internationally-accepted and widely-adopted list of indicators is the core list of ICT indicators developed by the Partnership on Measuring ICT for Development, a multi-stakeholder initiative launched in 2004.[24] This list includes, among others, the key-infrastructure, access and individual-use indicators that ITU collects and disseminates. Some of these indicators are amenable for augmentation using big data analytics.[25]

The core indicators on ICT infrastructure and access include indicators on mobile-cellular and mobile-broadband subscriptions, which remain some of the most widely used and internationally comparable telecommunication indicators produced for tracking the information society. One of the main issues with mobile-cellular and mobile-broadband subscription data is that they do not refer to unique subscriptions, or mobile users. Since one person can have multiple subscriptions, or share a subscription with another person, it is not possible to determine how many individuals subscribe to, or use, the mobile service. It is often the case that countries with large numbers of prepaid subscriptions display relatively high penetration rates since prepaid cards can often be purchased at no initial cost and do not involve a recurring (monthly) cost. In countries with high interconnection charges, for example, multiple prepaid cards can help avoid high costs when making off-net calls. In addition, prepaid consumers do not usually cancel their account after ceasing to use a given network, making it important for operators to monitor the time during which a SIM card remains inactive. In June 2014, for example, GSMA estimated that, globally, the number of unique mobile subscriptions was just over 50 percent, whereas the number of connections per 100 population far exceeded 100 per cent.[26]

Survey-based data, for example on Internet users and mobile-phone users, do not entail the same issues as subscription data. They are collected through household surveys, directly from citizens, and their level of reliability is relatively high. The advantage of surveys is that they can go into more depth on the use of ICTs. For example, one of the core indicators reflects the types of online activity pursued by Internet users, and includes response categories such as seeking health information, obtaining information from government entities or participating in social networks. Survey-based data can also be broken down by individual characteristics, including gender, age, educational level and occupation, which substantially increase the data's added value. However, the main challenge with these data is that they are not widely available (in particular, many developing countries do not yet collect data on individual use of, or household access to, ICTs), are relatively expensive to produce, and are much less timely than subscription data (often with a time lag of one year). Consequently, data on users of the information society and the types of online service they consume are limited, and in many cases outdated. Against this background, mobile networks and mobile big data could be used to identify alternative, less costly and faster ways of carrying out representative surveys (Box 5.9).

Given the shortcomings of existing administrative data from operators and survey data collected by NSOs, it is particularly interesting to assess some of the ways in which big data can be used to overcome the shortcomings of existing key ICT indicators and to provide additional insights into ICT access and use, user behaviour, activities and also the individual user. Big data could help in obtaining more granular information in several areas, and big data techniques could be applied to existing data to produce new insights. In particular, operators' big data could produce information in the following areas:

Individual subscriber characteristics: Additional categorization across both time and space are possible for subscription indicators, and big data could provide additional information on gender, socio-economic status and user location. Information on gender or age, for example, could be derived from customer registration information (notwithstanding a number of challenges and privacy issues, as discussed later in Section 5.5). The socio-economic status of the person linked to a subscription could be derived from big data techniques applied to users' consumption information, as well as other data contained in customer registration information. In addition, the analysis of customers' mobility patterns will often allow for an understanding of important locations (work and home being the two most important) and of the use of mobile services in rural versus urban areas. It would thus be possible to gain a more reliable and more granular understanding of service penetration across space on the basis of actual behaviour/activity, rather than of what customers may report through a survey.

Service activity and use: All subscription data could provide information as to location. In the case of fixed-telephone and fixed-broadband subscriptions, which are linked to an address through the billing information, it is possible to obtain information on the administrative division of subscribers, distinguish between urban and rural areas, and provide breakdowns by any kind of geographic categorization. Operators could track the types of service that a subscriber uses and the frequency and intensity of use of each of them. Similarly, when it comes to broadband access, operators can also potentially produce detailed information on the technology being used by the subscriber, as well as the associated speed and quality of access for each of the technologies used. Based on the household/individual details provided during the registration process, it could also be possible to provide more information on individual/household characteristics, or to link those characteristics to other (administrative) databases in order to

Box 5.9: Using mobile big data and mobile networks for implementing surveys

An important measurement for assessing the development of the information society is the extent to which households have access to ICTs. Given the need for continued recourse to surveys for collecting the corresponding data, and the declining response rates where traditional surveys are concerned (Groves, 2011), mobile operators could develop platforms to facilitate the collection of survey data. This could include targeting a wide variety of respondents covering the full spectrum of appropriate demographic profiles, followed by a process of extrapolation using big data analytics. In 2011, for example, UN Global Pulse partnered with Jana,[27] a mobile-technology company, to explore the feasibility of using mobile phones for the deployment of rapid global surveys on well-being.[28] This requires, however, that the mobile users targeted for the survey match the requisite survey profile. For instance, if one of the requirements was for the survey to be representative of women, there would have to be some way to determine/infer the demographics of the targeted mobile-phone user. To that end, the World Bank has experimented with the use of mobile phones to conduct statistically representative monthly household surveys in Latin America and the Caribbean.[29]

Source: ITU.

create new information. Consumption patterns could also deliver additional information on the socio-economic status of the person/household linked to a subscription.

Particularly rich possibilities exist where data from mobile-cellular and mobile-broadband subscriptions are concerned, since they are linked to mobility profiles. The indicators for such subscriptions could be further broken down to understand the utilization of services – including voice, data and VAS – over time, and the intensity of use. Mobile operators are able to provide information not only on the different technologies (3G, LTE-Advanced, etc.), but also on the types of service that subscribers are using, and the frequency and intensity of that use. They could, therefore, potentially identify Internet and VAS usage patterns between rural and urban areas, and identify the kinds of application or webpage that mobile-Internet users access. Combined with individual subscriber characteristics, this information could provide new and rich insights into the digital divide and help understand usage patterns, including intensity of use, by gender, socio-economic status and also location.

Greater utilization of DPI could lead to additional insights that can help to classify access and intensity of use with respect to different Internet activities carried out by individuals. This information is currently collected only by countries that carry out household ICT surveys. In addition, mobile-operator data could be combined with customer information from popular online services, such as Facebook, Google or other, local (financial, social etc.) services to provide additional insights. This could be done by using probabilistic analyses to match the profiles developed using data from online services with customer profiles generated from analyses of mobile-operator data. This would require telecommunication operators, OTT providers and other Internet content providers to work together and share information.

This technique is, currently, probably the least developed one, also because of the lack of a good ontology and of privacy issues. However, as operators seek to gain a better understanding of their customers in terms of the type of content they consume (as revealed through clickstream analyses), DPI may provide greater insights for measuring the information society. In addition, if websites could be individually classified in terms of the information they provide, then Internet-user activities, including their frequency and intensity, could be much better understood.

By applying big data techniques to survey data and administrative data from operators, new insights could be derived, in particular, in respect of the following:

Subscriptions versus subscribers: Big data techniques could help extrapolate the actual number of unique mobile subscribers or users, rather than just subscriptions, by comparing subscription numbers to user numbers derived from household surveys, and by taking into account usage patterns or data from popular Internet companies such as Google or Facebook. By linking data collected from different sources and combining subscription data and usage patterns, a correlation algorithm could be developed to reverse engineer approximate values for these indicators, in order to estimate user numbers in between surveys, and possibly in real time. This could be pursued in a similar way to the work done by Frias-Martinez and Virseda (2012) on estimating socio-economic variables using mobile-phone usage data, as described in greater detail at the beginning of this section. It is important to note here that, depending on such correlation techniques, big data methods only complement existing surveys rather than replacing them completely (see Section 5.5 for a further discussion of this).

In sum, relatively simple big data techniques can help analyse and provide complementary information on existing ICT data, and provide new insights into the measurement of the information society. This includes information on the use of different services and applications, intensity, frequency, and the geographic locations from which subscribers access ICT services and applications. All of these insights on subscribers could potentially be further disaggregated by different demographic and socio-economic profiles. However, all of them relate to subscriptions. Given multiple SIM usage and the fact that users will in many cases be using ICT services from more than one operator or device, additional techniques need to be leveraged if the insights articulated for subscribers are to be extended to unique individuals. Such techniques will often include combining data from surveys with big data to build new correlation and predictive analytic techniques.

Finally, it should be noted that the methods that could help improve the indicators on individual and household access and use could also be used to complement information on the use of ICTs in businesses, as well as the health and education sectors. In all cases, and for other big data for development projects, big data analysis cannot replace survey data, which is needed to build and test correlations and to validate big data results.

While the opportunities discussed above present what is analytically possible, data access and privacy considerations are complex and nuanced, and therefore place constraints on what is practically feasible or advisable. Section 5.5 discusses these challenges in greater detail.

5.5 Challenges and the way forward

Attempting to extract value from an exponentially growing data deluge of varying structure and variety comes with its share of challenges. The most pressing concerns are those associated with the standardization and interoperability of big data analytics, as well as with privacy and security. Addressing such privacy and other concerns with respect to data sharing and use is critical, and it is important for big data producers and users to collaborate closely in that regard. This includes raising awareness about the importance and potential of producing new insights, and the establishment of public-private partnerships to exploit fully the potential of big data for development.

Data curation, standardization and continuity

Data curation and data preparation help to structure, archive, document and preserve data in a framework that will facilitate human understanding and decision-making. Traditional curation approaches do not scale with big data and require automation, especially since 85 per cent of big data are estimated to be unstructured (TechAmerica Foundation, 2012). Dealing with large heterogeneous data sets calls for algorithms that can understand the data shape while also providing analysts with some understanding of what the curation is doing to the data (Weber, Palmer and Chao, 2012).

Telecom network operators themselves have to contend with interoperability issues arising from the different systems (often from different vendors) they employ. It is not uncommon for operators to write customized mediation software to overcome potential inter-comparability issues among data from different systems. The problems are compounded when one has to take account of secondary third-party users that may seek to leverage the data. The framework used by an NSO to organize data would be different from that used by a network engineer or a marketing or business intelligence specialist. Naturally, telecom network operators have curated their data based on their needs. To be able to use telecom big data for development and monitoring, and to guarantee its continuity, the creation of a semantic framework would require greater consensus among the many diverse stakeholders involved (telecom operators, network equipment manufacturers, system developers, developmental practitioners and researchers, NSOs, etc.).

Accessing and storing data, and data philanthropy

Big data for development is still in its nascent stages and, as such, comes with its share of challenges, not least of which is obtaining access to what is essentially private data. Private corporations would hesitate to share information on their clients and their business processes in case such sharing is illegal, precipitates a loss of user confidence and/or accidentally reveals competitive business processes. More importantly, companies will not share until there are incentives to do so. Until holders of big data become more comfortable about their release, it is going to be difficult for third-party research entities to gain access.

Researchers (mainly from developed countries, with some exceptions such as LIRNE*asia*) have recently succeeded in obtaining mobile-network big data, but it has taken them considerable time to build and leverage the necessary relationships with operators. Such privileged access is for the most part conditioned by lengthy legal agreements whose preparation requires major investments of time. All the parties to such agreements have to address the necessary parameters as to how data are to be used, including the manner in which they are to be anonymized and extracted, and with regard to time periods for access, etc. Even once agreements are in place, both researchers and operators face costs arising from the technical challenges associated with extraction of the data, on account of different curation approaches and problems relating to the interoperability of different systems.

Some mobile operators are taking tepid steps towards sharing data more publicly. Orange, for example, hosted a "Data for Development Challenge," releasing an aggregated anonymized mobile dataset from Côte d'Ivoire to researchers and convening a conference at MIT in early 2013, where 84 papers from different researchers were presented. A follow-up conference, this time using Orange data from Senegal, is planned for 2015.[30] In 2014, Telecom Italia initiated a similar challenge, making data from the territories of Milan and the Autonomous Province of Trento available to researchers for analysis.[31] It has, however, gone one step further: in addition to releasing some of its own telecom datasets, it partnered with other data providers to curate and release additional big datasets containing weather, public and private transport, energy, event and social network data. In both the Orange and Telecom Italia cases, researchers had to go through an approval process in order to gain access.

Organizations such as UN Global Pulse are seeking to popularize the concept of "data philanthropy", aimed at systematizing the regular and safe sharing of data by building on the precedents being created by the ad hoc activities outlined earlier. Such efforts by UN Global Pulse, as well as by other organizations such as LIRNE*asia*, that seek to bring different stakeholders to the same table, remain critical to the efforts being made to open up private-data stores in order to obtain actionable development insights.

There is a gap that needs to be addressed if large-scale pooling and sharing of such data are to become a reality. Cross-sector and cross-domain collaboration would benefit greatly from facilitators or intermediaries capable of addressing issues related to standardization and data-curation practices when pooling data from multiple sources. This facilitatory role may even be played by a third-party organization able to subsume regulatory and privacy burdens faced by data providers, effectively acting as a gatekeeper to ensure that data are used transparently and in a way that contributes to overall scientific knowledge generation, while ensuring that any safeguards that may be applicable in respect of private information are applied. Such an approach was taken recently by the pharmaceutical company Johnson and Johnson, which decided to share all of its clinical trial data. To facilitate the process, they hired Yale University's Open Data Access (YODA) Project to act as gatekeepers (Krumholz, 2014). YODA undertakes the necessary scientific review of any proposals (from scientists around the world) to make use of the data and ensures that necessary privacy and data usage guidelines are followed.[32]

The question remains as to who is best placed to act as gatekeepers and standard-bearers when it comes to telecom network big data. Some have argued that NSOs are well placed to ensure that best practices are followed in the collection and representation of big data, and to provide a stamp of trust for potential third-party data seekers. Telecom operators, for their part, are mostly regulated by sector-specific regulators who can also have purview and dictate terms governing the privacy and data-reporting responsibilities of operators. Ultimately, however, the decision as to who takes on the gatekeeper and standardization function requires the confluence of multiple actors. It is here that organizations such as ITU, UN Global Pulse and others have a greater role to play in building an institutional model for data sharing and collaboration, in consultation with all stakeholders.

The sharing (subject to appropriate privacy protocols) of privately held data such as mobile-phone records can be mutually beneficial to both government and private sector. For example, mobile-network operators monitor and forecast their revenue at the cell-tower level. Emerging research in Africa shows how reductions in revenues, including airtime top-ups, could presage declines in income in specific regions. This could allow for targeted and timely policy actions by government to address the underlying problems, which would not be possible with the delayed insights provided by traditional statistics. Such a collaborative early-warning and early-action system shows how data sharing could be considered a business risk mitigation strategy for operators in emerging markets. However, such cooperation is predicated on opening up the currently privileged access that a few researchers and organizations have been given to mobile-operator datasets.

Finally, it should be noted that the emergence of big data is closely linked to advances in the ICT sphere, including the falling cost of data storage. Depending on the data volume, storage can still be costly, especially where privacy considerations pre-empt the use of specialized third-party cloud-based services. But as storage prices continue to fall, they are expected to be less of an issue.

Privacy and security

As social scientists look towards private data sources, privacy and security concerns become paramount. To mitigate the potential risks, all stakeholders must see tangible benefits from such data sharing. These stakeholders include not just the public and private sectors, but also, significantly, the general public, who in many cases are the primary producers of such data through their activities. It is also the public that must ultimately decide on how the data they produce may be used. The World Economic Forum's "Rethinking Personal Data" project has identified key trust challenges facing the personal data economy, and hosts consultations to deepen understanding of what type of trust frameworks are needed between individuals and the private and public sectors in today's new data ecosystem.[33] Discussions must address the individual's privacy expectations, as well as those of private-sector stakeholders looking to protect their competitiveness. The most common approach to addressing this issue has been the rights-based approach. ITU, for example, has defined individual privacy as "the right of individuals to control or influence what information related to them may be disclosed" (ITU, 2006).[34] Central to the rights-based privacy framework is the implicit or explicit existence of personal data that needs to be protected. OECD, for example, defines personal data as "any information relating to an identified or identifiable individual (data subject)" (OECD, 2013). The result of such an approach has been the policy of "inform and consent" practised by most companies to inform users of what data are being collected and how they will be used. It has been argued, however, that in a big data world the "inform and consent" approach is woefully inadequate and impractical, and that a new approach is needed (Mayer-Schönberger and Cukier, 2013; WEF, 2013).

Firstly, user-privacy policies have morphed into long documents written in 'legalese' that most users can hardly comprehend and have little patience for reading in full. Secondly, in the big data paradigm, the greatest potential often lies in secondary uses, which may well manifest long after the data was originally collected. It is thus impractical for companies to have *a priori* knowledge of all the potential uses and to seek permission from the user every time such a new use is found. Given the volumes of data that individuals are now generating, companies would find themselves struggling to maintain meaningful control.

Of greater concern is how to articulate the privacy issues that may arise when data from one source is combined with data from other sources to reveal/infer new data and insights. This blurs the lines between personal and non-personal information, allowing seemingly non-personal data to be linked to an actual individual (Ohm, 2010). Digitized behavioural data crumbs may in fact greatly diminish personal privacy. The use of DPI, for example can technically reveal all of a user's online activity. Going one step further, it is possible to understand a person's needs, behaviours and preferences by using data-mining techniques on the digital breadcrumbs. For instance, a recent study showed how Facebook "likes" could accurately predict a range of behavioural attributes such as, inter alia, sexual orientation, ethnicity, religious and political views, and use of addictive substances (Kosinski, Stillwell and Graepel, 2013).

Data anonymization[35] (i.e. methods designed to strip data of personal information), employed by computational social scientists, has been called into question (Narayanan and Shmatikov, 2008). A recent study of mobile CDRs for 1.5 million anonymized users covering a 15 month period showed how the authors were able to identify 90 per cent of the users with just four data points, and 50 per cent with just two points (de Montjoye, Hidalgo, Verleysen and Blondel, 2013). Although the actual real-world identities of the users were unknown, the authors point out that the data could in fact be de-anonymized completely by cross-referencing them with other data sources. The attendant privacy concerns about such cross-referencing are clear, and have to be taken seriously and addressed.

However such de-anonymization concerns remain, for the time being, somewhat premature for developing countries, mainly because the levels of 'datafication' in developing economies are still quite low. Where mobile-phone records are concerned, the large majority of connections in the developing world are prepaid, with minimal (if any) associated registration information. Security imperatives have increasingly prompted governments to require registration information, even for prepaid customers (GSMA, 2013b), but even with registrations becoming mandatory for prepaid connections, the registered user and the actual user may not be one and the same. Depending on the country, SIM resellers may pre-register the SIMs they sell under their own name, and SIMs that are registered by one family member may be used by other members of the same family. Sri Lankan operators, for example, see a great mismatch between the person registering a subscription and the person using it. The same may also be the case in many other developing countries.[36]

Irrespective, there is a consensus that there have to be safeguards in place, be they technological, conceptual, legal or, more likely, a combination of all three. These safeguards must also ensure that data are kept secure. Data breaches undermine consumer confidence and hinder efforts to exploit big data for the greater social good. Encryption, virtual private networks (VPNs), firewalls, threat monitoring and auditing are some potential technical solutions that are currently employed, but they need to be mainstreamed (Adolph, 2013). The paradigmatic shift required to address privacy has started, but it will be some time before a consensus is achieved on the most appropriate method(s). In response to the growing trend to unlock socio-economic value from the rising tide of big data, the World Economic Forum (WEF) initiated a global multi-stakeholder dialogue on personal data that advocated a principle-based approach, with the principles arising from a new approach that shifts governance from the data per se to its use; acknowledges the importance of context rather that treating privacy as a binary concept; and acknowledges the need for new tools to actively engage users, enabling them to make clear choices based on an actual value exchange (WEF, 2013).

Given the complexity of the questions related to privacy and data protection in a big data world, the danger is that these questions may take too long to resolve and further delay the potential use of big data for broader development. Hence, a balanced risk-based approach may be required in the context of what is under discussion here, i.e. the use of telecom big data for monitoring and development. This does still require the confluence of appropriate stakeholders. But as UN Global Pulse suggests, research into the use of big data for development can be "sandboxed", with appropriate privacy protections imposed on researchers, while still ensuring that the broader privacy implications and solutions continue to be discussed and worked out.[37]

Veracity in data, analysis and results

"Garbage in, garbage out", or GIGO for short, is a computer science concept that refers to the fact that the veracity of the output of any logical process depends on the veracity of the input data. In the big data paradigm, it is easy to overlook that concept, given the expectation that when dealing with vast volumes of (often unstructured) data from a multitude of sources, "messiness" is to be expected. As Mayer-Schönberger and Cukier (2013) note, "What we lose in accuracy at the micro level we gain in insight at the macro level." This common conception can often be misleading. Data quality and their provenance do matter, and the question is important in establishing the generalizability of the big data findings.

Data provenance and data cleaning

Understanding data provenance involves tracing the pathways taken by data from the originating source through all the processes that may have mutated, replicated or combined the data that feed into the big data analyses. This is no simple feat. Nor, given the varied sources of data that are utilized, is it always as feasible as the scientific community would wish. However, at the very least it is important to understand some aspects of the origin of data. For example, the fact that some mobile-network operators choose to include the complete routing of a call that has been forwarded means that there may be multiple records in the CDRs for the same call. If that is not taken into consideration, the subsequent social network analysis could contain errors (overstating or understating tie strength, for example). While it may not be possible to establish data provenance as envisaged by scientists, it is at the very least important to understand the underlying processes that may have created the data.

Data cleaning remains a key part of the process to ensure data quality. It is important to verify that the quantitative and qualitative (i.e. categorical) variables have been recorded as expected. In a subsequent step, outliers must be removed, using decision-tree algorithms or other techniques. However, data cleaning itself is a subjective process (for example, one has to decide which variables to consider) and not a truly agnostic one as would be desirable, and is thus open to philosophical debate (Bollier, 2010).

Are the data representative?

Related to the question of data provenance is the issue of understanding the underlying population whose behaviour has been captured. The large data sizes may make the sampling rate irrelevant, but they do not necessarily make it representative. Not everyone uses Twitter, Facebook or Google. For example, ITU estimates suggest that 40 per cent of the world's population uses the Internet. In other words, more than four billion people globally are not yet using the Internet, and 90 per cent of them are from the developing world. Of the world's three billion Internet users, two-thirds are from the developing countries. Even though mobile-cellular penetration is close to 100 per cent, this does not mean that every person in the world is using a mobile phone. This issue of representativeness is of high relevance when considering how telecommunication data may be used for monitoring and development. While the potential benefits to be gained from leveraging mobile-network operator data for monitoring and development purposes hinges on the large coverage, close to the actual population size, it is nevertheless not the whole population. Questions such as the extent of coverage of the poor, or the levels of gender representation among telecom users, are all valid considerations. While the registration information might provide answers, the reality is that the demographic information on telecom subscribers, for example, is not always accurate. With prepaid subscriptions being the norm in most of the developing world, the demographic information contained in mobile-operator records is practically useless, even with mandatory registration as discussed above.

The issue of sampling bias is best illustrated by the case of Street Bump, a mobile app developed by Boston City Hall. Street Bump uses a phone's accelerometer to detect potholes while users of the app are driving around Boston and notifies City Hall. The app, however, introduces a selection bias since it is slanted towards the demographics of app users, who often hail from affluent areas with greater smartphone ownership (Harford, 2014). Hence, the "big" in big data does not automatically mean that issues such as measurement bias and methodology, internal and external data validity and data interdependencies can be ignored. These are fundamental issues not just for "small data" but also for "big data" (Boyd and Crawford, 2012).

Behavioural change

Digitized online behaviour can be subject to self-censorship and the creation of multiple personas, so studying people's data exhaust may not always give us insights into real-world dynamics. This may be less of an issue with TGD, where in essence the data artefact is itself a by-product of another activity. Telecom network big data, which mostly fall under this category, may be less susceptible to self-censorship and persona development, but the possibility of these phenomena cannot be ruled out. Nor is it inconceivable that users may stop using their mobiles, or even turn them off, in areas where they do not wish their digital footprint to be left behind. In a way, big data analyses of behavioural data are subject to a form of the Heisenberg uncertainty principle, whereby as soon as the basic process of an analysis is known, there may be concerted efforts to exhibit different behaviour and/or actions to change the outcomes (Bollier, 2010). For example, the famous Google page-rank algorithm has spawned an entire industry of organizations that claim to enhance website page rankings, and search-engine optimization (SEO)[38] is now an established part of website development.

Changes in behaviour could also partially explain the declining veracity of Google Flu Trends (GFT), researchers having found influenza-like illness rates as reflected by Google searches to be no longer necessarily correlating with actual influenza virus infections (Ortiz et al., 2011). Recent research has shown that since 2009 (when GFT failed to reflect the non-seasonal influenza outbreak), infrequent updates have not improved the results and GFT has in fact persistently overestimated flu prevalence (Lazer, Kennedy, King and Vespignani, 2014). GFT does not and cannot know what factors contributed to the strong correlations found in its initial work. The point is that the underlying real-world actions of the population that turned to Google with its health queries, and which contributed to the original correlations identified by GFT, may in fact have changed over time, diminishing the robustness of the original algorithm. For example, the enthusiasm surrounding GFT may well have created rebound effects, with more and more people turning to Google with their broader health questions, thereby introducing additional search terms (due to different cultural norms and/or ground conditions) and collectively introducing biases for which GFT has been unable to account. Such potential problems could have been foreseen and resolved had the GFT method been more transparent (see Section 5.2).

Real-world context

Knowing and understanding the real-world context therefore remains important when considering big data analyses for monitoring purposes. Dr Nathan Eagle, a pioneer in the use of cellphone records to understand phenomena related to social development and public health, stresses the importance of weeding out false assumptions by conducting an a priori survey of even a small number of people. For example, in one instance, when CDR data from Rwanda showed low mobility in the wake of flooding, he theorized that this was due to an outbreak of cholera. A ground survey, however, revealed the true cause of the low mobility to be washed-out roads (David, 2013). A knowledge of ground conditions and context is also relevant when it comes to the generalizability of telecom-data analyses based on big data. For example, prior research had established a power-law distribution between the frequency of airtime recharges and average recharge amount.[39] It was further found that the poor tended to top up more frequently but in smaller amounts by comparison with those higher up on the socio-economic ladder (UN Global Pulse, 2012). When researchers working with Sri Lankan mobile datasets attempted to use these findings to help them segregate their analyses for different socio-economic groups, they were unable to do so. A survey of local context based on interviews with operators provided the reason: almost two-thirds of prepaid customers generally chose to recharge using scratch cards. Higher denomination scratch cards were not as readily available as those with lower denominations. Hence, anyone wanting to reload a higher amount often bought multiples of lower-denomination cards. After recharging with one card, the rest were kept aside for when the need arose. A lack of awareness of this local context would have led researchers to assume, mistakenly, that differing airtime-credit purchasing patterns among different socio-economic groups were not prevalent within the Sri Lankan population.

Causation versus correlation

It is easy to confuse correlation with causation in the big data paradigm, leading to the discovery of misleading patterns. As Google's Chief Economist, Hal Varian, notes, "there are often more police in precincts with high crime, but that does not imply that increasing the number of police in a precinct would increase crime" (Varian, 2013b). Big data draws many of its techniques from machine learning, which is primarily about correlation and predictions.[40] Big data are by their very nature observational and can measure only correlation and not causality. Supporters of big data have predicted the end of theory and hypothesis-testing, with correlation trumping causality as the most relevant method (Anderson, 2008; Mayer-Schönberger and Cukier, 2013). However, such predictions may be premature. The behavioural economist Sendhil Mullainathan notes that inductive science (i.e. the algorithmic mining of big data sources) will not drown out traditional deductive science (i.e. hypothesis testing), even in a big data paradigm. Among the three Vs in the traditional big data definition, volume and variety produce countervailing forces. More volume makes big data induction techniques easier and more effective, while more variety makes them harder and less effective. It is this variety issue that will ensure the need for explaining behaviour (i.e. deductive science) rather than merely predicting it (Mullainathan, 2013).

Causal modelling is possible in a big data paradigm by conducting experiments. Telecom network operators themselves use such techniques when rolling out new services or, for that matter, for pricing purposes. The question, then, is how third-party researchers will be able to leverage operators' systems in order to conduct such experiments. There is no simple answer to this, since these are proprietary systems and the issue will have to be addressed.

The role of traditional "small data" in verification

The documented failures of GFT also point to the importance of traditional statistics as corroborating evidence. For example, the true value of GFT is realized only through its pairing with "small data," in this case the statistics collected by the Centers for Disease Control and Prevention (CDC). In fact, as Lazer et al. (2014) note, when combined with small data, "Greater value can be obtained by combining GFT with other near–real time health data." Where data from mobile-network operators are used for syndromic surveillance, as in the case of malaria in Kenya (Wesolowski et al., 2012a), big data are most useful as a basis for encouraging timely investigation, rather than as a replacement for existing measures of disease activity. Even when engaging with the broader question of how telecommunication network data could be used for monitoring, surveys and supplemental datasets will remain important to sharpen the analyses and especially to verify the underlying assumptions. For instance, Blumenstock and Eagle (2012) ran a basic household survey against a randomized set of phone numbers prior to data anonymization to build a training dataset. This enabled them, for example, to understand variations in mobility, social networks and consumption among men and women, and between different socio-economic groups, which would not have been possible using only the call records. Similarly, Frias-Martinez and Virseda (2012) needed census data to build their algorithms and provide training data for their algorithms to reverse engineer approximate survey maps. Official statistics will thus continue to be important to building the big data models and for periodic benchmarking so that the models can be fine-tuned to reflect ground realities.

Transparency and replicability

The issues with GFT also illustrate transparency and replicability problems with big data research. The fact that the original private data may in many cases not be available to everyone underscores the importance of opening up such private-data sources (in a manner that addresses potential privacy concerns) or of peer reviews that can hone and improve the analyses. Instead, consumers of such research have no option but to take the analysis and the results on faith. In the case of GFT, for example, the researchers, in their original Nature paper (Ginsberg et al., 2009), did not publish the original 45 search terms that had been used to make the correlation, rendering replicability impossible. Indeed, where methods are transparent they can be updated more effectively when ground realities change – something that could have prevented the problems with GFT.

Skills

Engaging with and extracting value from big data calls for a combination of specialized skills in the areas of data mining, statistics and domain expertise, as well as data preparation, cleaning and visualization. NSOs may have deep statistical skills in house, but this is not enough when it comes to working with large volumes of big data calling for computer science and decision-analysis skills that are not emphasized in traditional statistical courses (McAfee and Brynjolfsson, 2012). NSOs recognize this shortcoming. In a recent global survey of NSOs from 200 economies, conducted by UNSC, respondents identified the development and retention of staff with the necessary skills as one of their main challenges, and identified intensive training and capacity development of their staff as a prerequisite to being able to exploit new big data sources (UNSC, 2013). Currently, there is a mismatch between the supply of and demand for talented individuals with the requisite broader skill sets, i.e. data scientists. McKinsey predicts that by 2018 the demand for data-savvy managers and analysts in the United States will amount to 450 000, whereas the supply will fall far short of this, at only 160 000 (Manyika et al., 2011). This suggests that organizations wishing to leverage big data for development will face competition from the private sector when seeking to attract the right talent. Unfortunately, developing countries, which stand to benefit the most from the use of telecommunication big data to complement official statistics, have a shortage of advanced analytical skills by comparison with developed economies. Until such time as systematic capacity development yields proper rewards, it will remain essential to import skills from outside (both local and international), despite the difficulties of attracting individuals with the right skill profiles.

The way forward

Current research suggests that new big data sources have great potential to complement official statistics and produce insightful information to foster development. In particular, the private sector, but also a number of development organizations, and governments have started to exploit this potential.

At the same time, this chapter argues that while there have been a number of research collaborations and promising proof-of-concept studies, no significant programme has yet been brought to a replicable scale. Future efforts to mainstream and derive full benefit from the use of big data will have to overcome a number of barriers. This includes the development of models which protect user privacy while still allowing for the extraction of insights that can serve development purposes, in particular where developing countries are concerned. Very limited information is available on opportunities for using big data to complement official ICT statistics. Although this report highlights some of the big data sources and techniques that could be used, further research is needed to understand and confirm the usefulness of big data sources for monitoring the information society.

As with other official statistics, it is paramount for big data producers and big data users to collaborate and to initiate a dialogue to identify opportunities and understand needs and constraints. Since many of the big data sources lie within the private sector, close cooperation between NSOs, on the one hand, and telecommunication operators and Internet companies, including search engines and social networks, on the other, is necessary and could be institutionalized through public-private partnerships.

Operators and Internet companies

Business interests will naturally provide operators and Internet companies with the incentive to talk to commercial vendors of big data analytics. In addition, operators and Internet companies can benefit greatly from engagement with academia and researchers to understand how to leverage big data for different purposes. Such engagement will also broaden their understanding of the limitations and assist them in the development of new methodologies, algorithms and software techniques that can be repurposed for business-use cases. Indeed, where the applications of data use for development are concerned, operators also have an interest in maximizing the economic well-being of their customer base.

Operators and Internet companies need to take advantage of their existing customer relationships to elicit a greater understanding of consumer concerns and needs in relation to privacy. They are well placed to develop a privacy framework, in consultation with other stakeholders.

Given their business concerns, operators and Internet companies may hesitate to pool and share their data with those from other sources (including from competitors), but this is something that is worth exploring. Combining big data sources has great potential to increase added value and produce new insights. There is scope for exploring established models for such pooling – for example, the sharing by banks of some of their customer data with credit bureaux.

Governments

Governments have different opportunities and different roles to play in the exploitation of big data for monitoring and development. They can use big data to identify areas where rapid intervention may be necessary, to track progress and make sure their decisions are evidence based, and to strengthen accountability. More and more governments are recognizing the importance of big data and have set up communities of practice and working groups to study their use and potential impact (UNSC 2013).

Governments should also facilitate the legislative changes that are required and take a lead in setting big data standards. To this end, national regulatory authorities (NRAs) and NSOs, in consultation with other national stakeholders, are best placed to lead the corresponding discussions and bring together the relevant stakeholders.

In particular, NSOs, given their legal mandate to collect and disseminate official statistics and set statistical standards, have an important role to play. They could become standards bodies and big data clearing houses that promote analytical best practices in relation to the use of big data for complementing official statistics and for development. Those standards, which NSOs are in the best position to enforce, would also have to encompass best practices in relation to data curation and metadata standards. To this end, NSOs must also prioritize the upgrading of the in-house technical skills they require in order to handle big data, while at the same time investing in the necessary computational infrastructure.

As the main regulatory interface to the telecom sector, NRAs are well placed to co-champion the national discussion on how telecommunication big data may be leveraged for social good. Regulators have a role to play in facilitating the introduction of legislation that addresses privacy concerns while encouraging data sharing in a secure manner. The following recommendations were made in a recently published ITU draft paper (ITU, 2014):

- **Establishing mechanisms to protect privacy**: Regulators could develop a regulatory mechanism that would shift the focus of privacy protection from informed consent at the point of collecting personal data to accountable and responsible uses of personal data. This mechanism would foresee a well-resourced privacy regulator with the expertise and power to enforce such a use-based privacy protection mechanism. In return, data users would be permitted to reuse personal data for novel purposes where a privacy assessment indicates minimal privacy risks.

- **Restricting the use of probabilistic predictions**: While the use of big data can help better decision-making through probabilistic predictions, this information should not be used against citizens. Regulators should restrict the ways in which government agencies and others can utilize big data predictions.

- **Fostering big data competition and openness**: Regulators could foster big data competition in increasingly concentrated big data markets, including by ensuring that data holders allow others to access their data under fair and reasonable terms.

International stakeholders

International stakeholders – including UN agencies and initiatives (such as ITU and UN Global Pulse), the Partnership on Measuring ICT for Development, ICT industry associations and producers of big data (Google, Facebook, etc.) – have an important role globally. More work is needed to understand fully the potential of big data and examine the challenges and opportunities related to big data in the ICT sector. To this end, the key international stakeholders have to work together to facilitate the global discussion on the use of big data.

UN Global Pulse, as one of the main UN initiatives exploring the use of big data, can do much to inform and motivate the discussion on global best practices and the use of big data for development.

Where using big data for monitoring the information society is concerned, new partnerships, including public-private partnerships between data providers and the ICT statistical community, including ITU, could be formed to explore new opportunities and address challenges, including in the area of international data comparability and standards.

As one of the main international bodies working on issues related to the telecommunication sector, ITU could leverage its position to facilitate global discussion on the use of telecom big data for monitoring the information society.

Together, ITU and UN Global Pulse could facilitate the work that needs to be done by NRAs and NSOs, through awareness raising and engagement on privacy frameworks, data sharing, and analytical global best practices. ITU could help reduce the transaction costs associated with obtaining telecommunication big data, for example by facilitating the standards-setting process. Standardized contracts for obtaining data access as well as standards on how the data are stored, collated and curated can collectively reduce the overall transaction costs of accessing and leveraging telecommunication big data for social good.

Academia, research institutes and development practitioners

The research into how telecom data may be used to aid broader development is being done mainly by academia, public and private research institutes and, to a lesser degree, development practitioners. This makes them important stakeholders in defining the state of the art with respect to leveraging big data for development. They, more than others, have been the first to engage with telecommunication operators with a view to using their data for development. They therefore understand the potential and challenges from multiple perspectives. Their collective experiences will be valuable as big data for development becomes mainstreamed.

Chapter 5 Annex

The mobile-telecommunication data that operators possess can be classified into different types, depending on the nature of the information they produce. They include traffic data, service access detail records, location and movement data, device characteristics, customer details and tariff data.

Traffic data

Operators use a range of metrics to understand and manage the traffic flowing through their networks. These include:

- Data volume: both uplink and downlink volumes for Internet traffic can be captured at various levels of disaggregation down to the individual subscriber, or even to the level of a base station (in the case of a mobile operator) or local switch (in PSTN networks). These can be analysed to understand subscriber demand for data at both an individual level and at aggregate levels, and the understanding thus gained can be used for billing purposes and for network management.

- Erlang: a dimensionless metric used by mobile-network operators to understand the offered and utilized network load.[41] Erlang data are used to understand the load on a base station at any given time.

- Call, SMS and MMS volumes are used for a variety of purposes from billing to customer relationship management, as well for network planning.

- Deep packet inspection[42] (DPI) is used to scan the information that goes over a network. Operators employ DPI to varying degrees, and it is not always feasible for the entire data stream to be captured and stored, owing to the storage requirements that would be needed and also to privacy concerns. Often only the header information, which includes originating and recipient Internet protocols (IPs), is captured for a variety of purposes, including to manage the network and understand the demand for particular applications and websites.

Service access detail records

Whenever a user utilizes a telecommunication service, each access is recorded not only for infrastructure management but also for billing purposes. Depending on the type of service, the resulting records may be referred to as call detail records (CDRs), SMS/ MMS detail records, Internet access detail records, etc., and may include the following information:

- A timestamp of when the service was accessed.

- The duration of use of the service (for example, duration of a call).

- The numbers of all parties communicating (for example, a CDR would include the numbers of the originating and terminating parties).

- Applicable charges for the access.

- The type of handset used.

- The technology used (2G, 3G, etc.).

The most common use of such data is for basic billing purposes, in addition to which they can be used to build a rich profile of customers, as outlined in Section 5.3.

Annex Box 1: Active versus passive positioning data

Passive positioning transaction generated data (TGD) is automatically generated by the network and captured in the operator's logs for billing and network management purposes, to understand network load and to keep track of the handset in relation to its network elements. Active positioning data (which is of relevance only to mobile networks) is location and movement data that is captured in response to a specially initiated network query to locate a handset using either network or handset-based positioning methods. GPS location data can also be considered as active positioning data.

Active positioning data

Active positioning data can be generated using either device-centric or network-centric methods, as well as via satellite (i.e. GPS). The use of these methods has developed either in response to national regulations requiring operators to capture higher-precision location data, and/or to a business case for providing location-based services. The large-scale capture of such higher-resolution data is undertaken mainly by operators in developed economies. Operators in developing economies use some of these methods, but often on a case-by-case basis, and not for their entire subscriber base.[43] However, this trend is currently changing, and an increasing number of regulators are considering mandating operators to collect higher-resolution location information.[44] The table below lists some of the active positioning methods used by network operators.

Passive positioning data

Passive location data are contained in the subscriber's registration information, which includes some form of mailing address (billing address in the case of postpaid). While fixed-telephone network operators have access only to static location data, mobile networks have much richer and dynamic location data.

CDRs, SMS detail records and Internet access records are the main sources of passive positioning data for mobile operators and reside in their data warehouses. These records include the ID of the antenna (cell ID), which in turn has a geolocation, an azimuth (i.e. antenna orientation information) and an angular tilt.[45] It is also possible to obtain such data in real time through data-mediation services, but these are not universally implemented.

Passive location data from the billing records are obviously sparse and generated only when the phone is used and when the network knows which cell a particular handset is currently connected to. However, many operators choose not to archive these data if they do not have a business case to justify the additional storage costs. Where they are archived, such cell-handoff data provide a time-stamped sequence of cells that the phone was attached to, and provides for a rich mobility profile as compared to the event-based billing records.

Passive positioning data based on cell IDs is inexpensive when compared to active positioning data, but the tradeoff lies in their lower precision, usually at the level of network cells. This lower-resolution location estimate can range from a few hundred metres in urban areas with a higher-density base station coverage, to a few kilometres, especially in rural areas with sparse coverage. Furthermore, handsets are not always served by the nearest antenna, for a variety of reasons associated with signal strength, topography and saturation loads at the nearest antenna during peak times. In addition, the nearest antenna may not be enabled for the network setting chosen by the user on the handset. For example, if the closest cell supports only 2G but the user has chosen to connect only to 3G networks, the handset will always connect to an antenna that supports 3G, even if it is further away. Despite these location errors or limitations that can occur in analyses using such passive location data, at an aggregate level (temporal and/or spatial) these data remain very valuable.

Source: ITU.

Location and movement data

Mobile networks can, depending on their sophistication, capture a range of movement and location variables, which can be broadly classified into two different types: passive and active positioning data (see Annex Box 1).

Device characteristics

All mobile user devices used to access mobile telecommunication services come with an international mobile station equipment identity (IMEI) number. This 15 or 16 digit number is captured whenever a device is used to access

Table Annex Box 1: Active positioning methods

Method	Description
Cellular triangulation using angle of arrival (AoA)	The AoA method uses data from base stations that have been augmented with arrays of smart antennas. It is then possible to determine the location of a handset by triangulating known signal angles from at least two base stations. The location estimate varies from around 50 to 150m and is often towards the latter end, especially when handsets are far from the base stations.
Cellular triangulation using time of arrival (ToA)	This method uses the geo-coordinates of the cell and augments that position, by also factoring the distance to the handset inferred from the round-trip time of a signal from the antenna to the handset (using three different base stations for triangulation). This positioning method works best for cell areas with a radius greater than 500m, so it is more suited for rural and semi-urban areas with sparser antenna coverage.
GSM-GPS and assisted GPS (A-GPS)	Both of these utilize the network (mainly via triangulation from multiple base stations) to augment the satellite signal. They are particularly useful in locations and situations where there is interference in the satellite signal (e.g. inside buildings). Such location data have high spatial resolution, but are costly for operators to implement.
Enhanced observed time difference (E-OTD)	E-OTD is a device-centric positioning technique requiring the handset to make the necessary location calculation, based on the signals from three or more synchronized base stations. The accuracy of such techniques range from 50 to 125m

Note/Source: For more information regarding these methods, refer to CGALIES (2002).

telecommunication services. In addition to serving as a unique serial number for the handset, parts of it can reveal information on the handset make and model, type of technology (e.g. 2G, 3G, LTE), and it can be used for the collective categorization of handsets. Furthermore, devices used to access the Internet (mobile handsets, routers, modems) also have a unique identifier known as a media access control[46] (MAC) address. Such identifiers can provide details of the device used to access the network. Mobile network operators can use the IMEI number to identify the specific mobile handset being used by a subscriber, and this in turn can provide some insight as to that subscriber's purchasing power. See Section 5.3 for more details.

Customer details

Telecom network operators capture various items of demographic data during the customer registration process. These can include the customer's age, gender, billing address and national identity card number (where available). In addition, operators store the order history of when services were activated and/or deactivated, specific service option preferences and the current account status, current international mobile subscriber identity[47] (IMSI) number associated with the customer's mobile number, MAC address of the customer's access device, IMEI number, etc.

These details, when coupled with the customer's service usage history, can collectively help build a rich customer/user and usage profile that the operator can leverage for a variety of purposes (see Section 5.3).

Tariff data

Operators maintain the complete tariff sheet and billing records for their current and past services. This information, which associates a customer with his/her usage patterns and history, is important since operators often have customized plans not only for different categories of subscriber, but also for individual customers. Mobile operators can associate such data with traffic data to understand the revenue that is being generated by specific network elements (e.g. base stations), not only retrospectively, but also, possibly, in real time.

Endnotes

1 The report of the UN Secretary-General's High-Level Panel of Eminent Persons on the post-2015 Development Agenda calls for a data revolution that *"would draw on existing and new sources of data to fully integrate statistics into decision-making, promote open access to, and use of, data and ensure increased support for statistical systems."* This suggests that efforts to improve the availability of, and complement, official statistics have turned to the search for new data sources, including big data. In addition, the European Statistical System Committee (ESSC) in 2013 adopted the Scheveningen Memorandum on «Big Data and Official Statistics», which acknowledges that Big Data represents new opportunities and challenges for Official Statistics, and which encourages the European Statistical System and its partners to effectively examine the potential of Big Data sources, see: http://epp.eurostat.ec.europa.eu/portal/page/portal/pgp_ess/0_DOCS/estat/SCHEVENINGEN_MEMORANDUM%20Final%20version.pdf.

2 This term was first discussed in 1991, although the term then used was "transaction-generated information" (McManus, 1990)

3 For more information, see http://www.cityofboston.gov/doit/apps/streetbump.asp.

4 See http://www.donotpay.treas.gov/About.htm.

5 In Europe, the collection and processing of personal data or information is currently regulated by Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data (Data Protection Directive)1 and Directive 2002/58/EC, as amended by Directive 2009/136/EC, on privacy and electronic communications (the ePrivacy Directive), which focuses more specifically on the processing of personal data in the electronic communications sector. Article 7 of the Data Protection directive establishes the principle of opt-in, according to which personal data cannot legitimately be processed without the consent of the data subject, except if necessary to preserve public order or morality, as well as to further the general interest of society or individuals. Building on this principle, Article 5 of the ePrivacy Directive further provides that the processing of personal data can be effected only with the consent of the data subject, who should be given clear and comprehensive information as to the manner and purpose of such processing, except where it is directly instrumental to the provision of a service which had been explicitly requested by the subject. See: http://policyreview.info/articles/analysis/big-data-big-responsibilities.

6 See https://www.google.org/denguetrends/.

7 A good example of this is the Conference Board Help Wanted OnLine (HWOL) data series that measures the number of new, first-time online jobs and jobs reposted from the previous month for over 16 000 Internet job boards, corporate boards and smaller job sites in the United States. More information can be found at http://www.conference-board.org/data/helpwantedonline.cfm.

8 See http://bpp.mit.edu/.

9 According to Peerreach.com, 20 per cent of Indonesia's online population uses Twitter, the second highest ratio in the world. See http://www.ibtimes.com/twitter-usage-statistics-which-country-has-most-active-twitter-population-1474852.

10 See http://www.broadband.gov/qualitytest/about/.

11 ITU World Telecommunication/ICT Indicators database, 17th edition, 2014, available at: http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx.

12 See http://blog.stephenwolfram.com/2013/04/data-science-of-the-facebook-world/.

13 Mobile phone records have been used to infer locations of economic activity within, and patterns of migration to, slum areas in Kenya (Wesolowski and Eagle, 2010) and internal migration in Rwanda (Joshua E. Blumenstock, 2012). Other work has sought to understand international societal ties in Rwanda (Joshua E. Blumenstock, 2011) and the effects of migration on societal ties in Portugal (Phithakkitnukoon, Calabrese, Smoreda and Ratti, 2011). Exploratory research in Latin America used mobile phone records to forecast the socio-economic levels of localities, thereby yielding approximate census maps (Frias-Martinez, Virseda-Jerez and Frias-Martinez, 2012). Mao, Shuai, Ahn and Bollen (2013) investigated the relationship between mobile phone usage and regional economic development in Côte d'Ivoire.

14 The term "metadata" is also used quite extensively to refer to TGD from telecommunication operators.

15 Deep packet inspection (DPI) is a process that utilizes specialized software to scan all of the data packets traversing a particular IP network. It can be employed by network operators (especially ISPs) to filter for malicious content (e.g. spam) or for understanding network traffic patterns with a view to optimizing their networks. For further information, see http://en.wikipedia.org/wiki/Deep_packet_inspection.

16 It should be noted that there is not a harmonized methodology for the allocation of revenues from bundled packages to each specific service. Taking into account the increasing trend towards the bundling of telecommunication services (e.g. double- and triple-play offers), revenue figures disaggregated per service are in most cases not comparable across operators and countries. For a more detailed discussion of this topic, see ITU (2014).

17 Clickstream analyses involve the collection of browsing histories in order to understand which sites were accessed, in what order and how much time was spent at each.

[18] Comments by SK Telecom CEO Jinwu So to Mobile Asia Expo attendees - http://www.lightreading.com/document.asp?doc_id=703298.

[19] For more information on Cignifi, see their website at http://www.cignifi.com/.

[20] The full report can be accessed at http://unstats.un.org/unsd/statcom/doc14/2014-11-BigData-E.pdf.

[21] Syndromic surveillance refers to the collection and analysis of health data about a clinical syndrome that has a significant impact on public health, with the data in question being used to drive decisions about health policy and health education.

[22] A vector-borne disease is a disease that is transmitted through an agent (person, animal or microorganism).

[23] A geographic information framework is a representation framework that codes the components of geospatial data in a standardized manner so as to facilitate analyses and data exchange.

[24] See http://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/partnership/default.aspx for more information regarding the partnership.

[25] For the latest list of core ICT indicators refer to 2014 edition of the "Manual for Measuring ICT Access and Use by Households and Individuals available at http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ITCMEAS-2014-PDF-E.pdf.

[26] See https://gsmaintelligence.com.

[27] Jana has integrated its systems with 237 mobile operators worldwide, giving them a reach of almost 2 billion subscribers, each of whom could be a potential survey respondent. For more information, see www.jana.com.

[28] For more information regarding this project, see http://www.unglobalpulse.org/projects/global-snapshot-wellbeing-mobile-survey.

[29] For more information regarding this project, see http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/EXTHDNETWORK/0,,contentMDK:23154296~menuPK:2880846~pagePK:64159605~piPK:64157667~theSitePK:514426,00.html.

[30] More information about the Data for Development (D4D) challenges using Orange data can be found at http://www.d4d.orange.com/home.

[31] See http://www.telecomitalia.com/tit/en/bigdatachallenge/contest.html.

[32] More information about the Yale University Open Data (YODA) project can be found at http://medicine.yale.edu/core/projects/yodap/index.aspx.

[33] For more information, and to view the outcome reports of this project, see http://www.weforum.org/issues/rethinking-personal-data.

[34] It should be noted that there is no single ITU definition of privacy, that the above definition is not universally accepted and that there are divergent views on the exact scope of the right.

[35] Anonymization and security techniques are very rich. For further information, see, for example, El Emam, K. (2013).

[36] Based on author interviews and conversations with operators in South Asia.

[37] See, for example, http://www.unglobalpulse.org/privacy-and-data-protection for an understanding of the privacy protections UN Global Pulse imposes on its researchers.

[38] SEO is an established marketing strategy whereby a website's structure and content are optimized to make the site more visible to the webpage-indexing process of one or more search engines, thereby ensuring that the website and/or webpage appears higher up in the results of a search query.

[39] In a power-law distribution, the functional relationships between two variables is such that the value of one variable varies as a power of the other.

[40] See, for example, Anderson, C. (2008) and Halevey et al. (2009).

[41] One Erlang could, for example, and depending on the operator, be equivalent to one person talking for 60 minutes or two people talking for 30 minutes each.

[42] DPI is a process that utilizes specialized software to scan all of the data packets traversing a particular IP network. It can be employed by network operators (especially ISPs) to filter for malicious content (e.g. spam) or for understanding network traffic patterns with a view to optimizing their networks. For further information, see http://en.wikipedia.org/wiki/Deep_packet_inspection.

[43] Based on interviews between LIRNEasia and operators in South and South-East Asia.

[44] For example, the new Unified License that applies to all Indian operators requires mobile operators to include location details of mobile customers in the CDRs. This is in addition to the cell ID and would have to have an accuracy estimate of up to 50m within three years of the new licence coming into effect. For more information, see Chapter VIII, § 8.5, of the sample regulation on the Indian Department of Telecommunications website (http://dot.gov.in/sites/default/files/Unified%20Licence_0.pdf).

[45] Most network operators use multiple sectorized antennas on a single base station. When a sectorized antenna is placed on the base station it needs to be properly positioned. This includes setting the direction of the antenna (assuming a horizontal plane covering 360 degrees). This direction is known as azimuth. The angular tilt is the downward tilt (on a vertical plane) of the antenna. For more information, see http://en.wikipedia.org/wiki/Sector_antenna.

[46] A media access control (MAC) address is a unique identifier that is assigned to network interfaces mostly by a hardware manufacturer. For example, the telecom operator captures the MAC address from a modem or router or handset that accesses its network and maintains the mapping of this network interface to a particular customer. For more information, see http://en.wikipedia.org/wiki/MAC_address.

[47] An international mobile subscriber identity (IMSI) number is a 15-digit number unique to the particular SIM in a subscriber's handset. The mobile operator's system retains a mapping between an IMSI number and the particular mobile number assigned to a user. The IMSI conforms to Recommendation ITU-T E.212. For more information, see http://en.wikipedia.org/wiki/International_mobile_subscriber_identity.

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Annex 1. ICT Development Index (IDI) methodology

This annex outlines the methodology used to compute the IDI, and provides more details on various steps involved, such as the indicators included in the index and their definition, the imputation of missing values, the normalization procedure, the weights applied to the indicators and sub-indices, and the results of the sensitivity analysis.

1. Indicators included in the IDI

The selection of indicators was based on certain criteria, including relevance for the index objectives, data availability and the results of various statistical analyses such as the principal component analysis (PCA).[1] The following 11 indicators are included in the IDI (grouped by the three sub-indices: access, use and skills).

a) ICT infrastructure and access indicators

Indicators included in this group provide an indication of the available ICT infrastructure and individuals' access to basic ICTs. Data for all of these indicators are collected by ITU.[2]

1. Fixed-telephone subscriptions per 100 inhabitants

Fixed-telephone subscriptions refers to the sum of active analogue fixed-telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents and fixed public payphones. It includes all accesses over fixed infrastructure supporting voice telephony using copper wire, voice services using Internet Protocol (IP) delivered over fixed (wired)-broadband infrastructure (e.g. DSL, fibre optic), and voice services provided over coaxial-cable television networks (cable modem). It also includes fixed wireless local loop (WLL) connections, which are defined as services provided by licensed fixed-line telephone operators that provide last-mile access to the subscriber using radio technology, when the call is then routed over a fixed-line telephone network (and not a mobile-cellular network). In the case of VoIP, it refers to subscriptions that offer the ability to place and receive calls at any time and do not require a computer. VoIP is also known as voice-over-broadband (VoB), and includes subscriptions through fixed-wireless, DSL, cable, fibre-optic and other fixed-broadband platforms that provide fixed telephony using IP.

2. Mobile-cellular telephone subscriptions per 100 inhabitants

Mobile-cellular telephone subscriptions refers to the number of subscriptions to a public mobile-telephone service which provides access to the public switched telephone network (PSTN) using cellular technology. It includes both the number of postpaid subscriptions and the number of active prepaid accounts (i.e. that have been active during the past three months). It includes all mobile-cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging and telemetry services.

3. International Internet bandwidth (bit/s) per Internet user

International Internet bandwidth refers to the total used capacity of international Internet bandwidth, in megabits per second (Mbit/s). It is measured as the sum of used capacity of all Internet exchanges offering international bandwidth. If capacity is asymmetric, then the incoming capacity is used. *International Internet bandwidth (bit/s) per Internet user* is calculated by converting to bits per second and dividing by the total number of Internet users.

4. Percentage of households with a computer

A computer refers to a desktop computer, a laptop (portable) computer or a tablet or similar handheld computer. It does not include equipment with some embedded computing abilities, such as smart TV sets, and devices with telephony as a main function, such as mobile phones or smartphones. *Household with a computer* means that the computer is available for use by all members of the household at any time. The computer may or may not be owned by the household, but should be considered a household asset.[3]

Data are obtained by countries through national household surveys and are either provided directly to ITU by national statistical offices (NSO), or ITU carries out the necessary research to obtain them, for example from NSO websites. There are certain data limits to this indicator, insofar as estimates have to be calculated for many developing countries which do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

5. Percentage of households with Internet access

The *Internet* is a worldwide public computer network. It provides access to a number of communication services, including the World Wide Web, and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only a computer – it may also be a mobile telephone, tablet, PDA, games machine, digital TV, etc.). Access can be via a fixed or mobile network. *Household with Internet access* means that the Internet is available for use by all members of the household at any time.

Data are obtained by countries through national household surveys and are either provided directly to ITU by national statistical offices (NSO), or ITU carries out the necessary research to obtain them, for example from NSO websites. There are certain data limits to this indicator, insofar as estimates have to be calculated for many developing countries which do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

b) ICT use indicators

The indicators included in this group capture ICT intensity and usage. Data for all of these indicators are collected by ITU.[4]

1. Percentage of individuals using the Internet

Individuals using the Internet refers to people who used the Internet from any location and for any purpose, irrespective of the device and network used, in the last three months. It can be via a computer (i.e. desktop computer, laptop computer or tablet or similar handheld computer), mobile phone, games machine, digital TV, etc.). Access can be via a fixed or mobile network.

Data are obtained by countries through national household surveys and are either provided directly to ITU by national statistical offices (NSO), or ITU carries out the necessary research to obtain them, for example from NSO websites. There are certain data limits to this indicator, insofar as estimates have to be calculated for many developing countries which do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

2. Fixed (wired)-broadband subscriptions per 100 inhabitants

Fixed (wired)-broadband subscriptions refers to the number of subscriptions for high-speed access to the public Internet (a TCP/IP connection). High-speed access is defined as downstream speeds equal to, or greater than, 256 kbit/s. Fixed (wired) broadband includes cable modem, DSL, fibre and other fixed (wired)-broadband technologies (such as Ethernet LAN, and broadband-over-powerline (BPL) communications). Subscriptions with access to data communications (including the Internet) via mobile-cellular networks are excluded.

3. Wireless-broadband subscriptions per 100 inhabitants

Wireless-broadband subscriptions refers to the sum of satellite broadband, terrestrial fixed wireless broadband and active mobile-broadband subscriptions to the public Internet.

- *Satellite broadband subscriptions* refers to the number of satellite Internet subscriptions with an advertised download speed of at least 256 kbit/s. It refers to the retail subscription technology and not the backbone technology.

- *Terrestrial fixed wireless broadband subscriptions* refers to the number of terrestrial fixed wireless Internet subscriptions with an advertised download speed of at least 256 kbit/s. This includes fixed WiMAX and fixed wireless subscriptions, but excludes occasional users at hotspots and Wi-Fi hotspot subscribers. It also excludes mobile-broadband subscriptions where users can access a service throughout the country wherever coverage is available.

- *Active mobile-broadband subscriptions* refers to the sum of standard mobile-broadband subscriptions and dedicated mobile-broadband data subscriptions to the public Internet. It covers actual subscribers, not potential subscribers, even though the latter may have broadband-enabled handsets. *Standard mobile-broadband subscriptions* refers to active mobile-cellular subscriptions with advertised data speeds of 256 kbit/s or greater that allow access to the greater Internet via HTTP and which have been used to set up an Internet data connection using Internet Protocol (IP) in the past three months. Standard SMS and MMS messaging do not count as an active Internet data connection, even if the messages are delivered via IP. *Dedicated mobile-broadband data subscriptions* refers to subscriptions to dedicated data services (over a mobile network) that allow access to the greater Internet and which are purchased separately from voice services, either as a standalone service (e.g. using a data card such as a USB modem/dongle) or as an add-on data package to voice services which requires an additional subscription. All dedicated mobile-broadband subscriptions with recurring subscription fees are included regardless of actual use. Prepaid mobile-broadband plans require use if there is no monthly subscription. This indicator could also include mobile WiMAX subscriptions.

c) ICT skills indicators

Data on adult literacy rates and gross secondary and tertiary enrolment ratios are collected by the UNESCO Institute for Statistics (UIS).

1. Adult literacy rate

According to UIS, the *Adult literacy rate* is defined as "the percentage of population aged 15 years and over who can both read and write with understanding a short simple statement on his/her everyday life. Generally, 'literacy' also encompasses 'numeracy', the ability to make simple arithmetic calculations." The main purpose of this indicator is "to show the accumulated achievement of primary education and literacy programmes in imparting basic literacy skills to the population, thereby enabling them to apply such skills in daily life and to continue learning and communicating using the written word. Literacy represents a potential for further intellectual growth and contribution to economic-socio-cultural development of society."[5]

2. Gross enrolment ratio (secondary and tertiary level)

According to UIS, the *Gross enrolment ratio* is the "total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school-year."

2. Imputation of missing data

A critical step in the construction of the index is to create a complete data set, without missing values. There are several imputation techniques that can be applied to estimate missing data.[6] Each of the imputation techniques, like any other method employed in the process, has its own strengths and weaknesses. The most important consideration is to ensure that the imputed data will reflect a country's actual level of ICT access, usage and skills.

Given that ICT access and usage are both correlated with national income, hot-deck imputation was chosen as the method for imputing the missing data, where previous year data are not available to calculate the growth rates. Hot-deck imputation uses data from countries with "similar" characteristics, such as GNI per capita and geographic location. For example, missing data for country A were estimated for a certain indicator by first identifying the countries that have similar levels of GNI per capita and that are from the same region and an indicator that has a known relationship to the indicator to be estimated. For instance, Internet use data of country A was estimated by using Internet use data of country B from the same region with similar level of GNI per capita and similar level of fixed Internet and wireless-broadband subscriptions. The same logic was applied to estimate missing data for all indicators included in the index.

3. Normalization of data

Normalization of the data is necessary before any aggregation can be made in order to ensure that the data set uses the same unit of measurement. For the indicators selected for the construction of the IDI, it is important to transform the values to the same unit of measurement, since some values are expressed as a percentage of the population/of households, whereby the maximum value is 100, while other indicators can have values exceeding 100, such as mobile-cellular and wireless-broadband penetration or international Internet bandwidth (expressed as bit/s per user).

There are certain particularities that need to be taken into consideration when selecting the normalization method for the IDI. For example, in order to identify the digital divide, it is important to measure the *relative* performance of countries (i.e. the divide among countries). Second, the normalization procedure should produce index results that allow countries to track progress of their evolution towards an information society over time.

A further important criterion for the selection of the normalization method was to choose one that can be replicated by countries. Indeed, some countries have shown a strong interest in applying the index methodology at the national or regional level. Therefore, certain methods cannot be applied, for example those that rely on the values of other countries, which might not be available to users.

For the IDI, the *distance to a reference measure* was used as the normalization method. The reference measure is the *ideal value* that could be reached for each variable (similar to a goalpost). In all of the indicators chosen, this will be 100, except for four indicators:

- International Internet bandwidth per Internet user, which in 2013 ranges from 136 (bits/s/user) to almost 6 445 759. Values for this indicator vary significantly between countries. To diminish the effect of the huge dispersion of values, the data were first transformed to a logarithmic (log) scale. Outliers were then identified using a cut-off value calculated by adding two standard deviations to the mean of the rescaled values, resulting in a log value of 5.90.

- Mobile-cellular subscriptions, which in 2013 range from 5.6 to 304 per 100 inhabitants. The reference value for mobile-cellular subscriptions was reviewed and lowered to 120. This value (120) was derived by examining the distribution of countries based on their mobile-cellular subscriptions per 100 inhabitants value in 2013. For countries where postpaid is the predominant mode of subscriptions, 120 is the maximum value achieved, while in countries where prepaid is dominant (57 per cent of all countries included in the IDI have more than 80 per cent prepaid subscriptions), 120 is also the maximum value that was reached by a majority of countries. It was therefore concluded that 120 is the ideal value that a country could reach irrespective of the type of mobile subscription that is predominant.

- Fixed-telephone subscriptions per 100 inhabitants, which in 2013 range from zero to 124. The same methodology was used to compute the reference value, resulting in a rounded value of 60 per 100 inhabitants

- Fixed (wired)-broadband subscriptions per 100 inhabitants. Values range from zero to 44.6 per 100 inhabitants in 2013. In line with fixed-telephone subscriptions, the ideal value was defined at 60 per 100 inhabitants.

After normalizing the data, the individual series were all rescaled to identical ranges, from 1 to 10. This was necessary in order to compare the values of the indicators and the sub-indices.

4. Weighting and aggregation

The indicators and sub-indices included in the IDI were weighted based on the PCA results obtained when the index was first computed.[7] Annex Box 1.1 presents the weights for the indicators and sub-indices.

5. Calculating the IDI

Sub-indices were computed by summing the weighted values of the indicators included in the respective subgroup.

Annex Box 1.1: Weights used for indicators and sub-indices included in the IDI

	Weights (Indicators)	Weights (Sub-indices)
ICT access		
Fixed-telephone subscriptions per 100 inhabitants	0.20	
Mobile-cellular telephone subscriptions per 100 inhabitants	0.20	
International Internet bandwidth per Internet user	0.20	0.40
Percentage of households with a computer	0.20	
Percentage of households with Internet access	0.20	
ICT use		
Percentage of individuals using the Internet	0.33	
Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	0.33	0.40
Wireless-broadband subscriptions per 100 inhabitants	0.33	
ICT skills		
Adult literacy rate	0.33	
Secondary gross enrolment ratio	0.33	0.20
Tertiary gross enrolment ratio	0.33	

Source: ITU.

- *ICT access* is measured by fixed-telephone subscriptions per 100 inhabitants, mobile-cellular subscriptions per 100 inhabitants, international Internet bandwidth per Internet user, percentage of households with a computer and percentage of households with Internet access.

- *ICT use* is measured by percentage of individuals using the Internet, fixed (wired)-broadband Internet subscriptions per 100 inhabitants and wireless-broadband subscriptions per 100 inhabitants.

- *ICT skills* are approximated by adult literacy rate, secondary gross enrolment ratio and tertiary gross enrolment ratio.

The values of the sub-indices were calculated first by normalizing the indicators included in each sub-index in order to obtain the same unit of measurement. The reference values applied in the normalization were discussed above. The sub-index value was calculated by taking the simple average (using equal weights) of the normalized indicator values.

For computation of the final index, the ICT access and ICT use sub-indices were given 40 per cent weight each, and the skills sub-index (because it is based on proxy indicators) 20 per cent weight. The final index value was then computed by summing the weighted sub-indices. Annex Box 1.2 illustrates the process of computing the IDI for Denmark (which tops the IDI 2013).

6. Sensitivity analysis

Sensitivity analysis was carried out to investigate the robustness of the index results, in terms of the relative position in the overall ranking, using different combinations of methods and techniques to compute the index.

Annex Box 1.2: Example of how to calculate the IDI value

	DENMARK			
	Indicators			**2013**
	ICT access	**Ideal value***		
a	Fixed-telephone subscriptions per 100 inhabitants	60		37.4
b	Mobile-cellular telephone subscriptions per 100 inhabitants	120		127.5
c	International Internet bandwidth per Internet user**	787'260		261'221
d	Percentage of households with a computer	100		93.1
e	Percentage of households with Internet access	100		92.7
	ICT use			
f	Percentage of individuals using the Internet	100		94.6
g	Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	60		40.2
h	Wireless-broadband subscriptions per 100 inhabitants	100		107.5
	ICT skills			
i	Adult literary rate	100		99.0
j	Secondary gross enrolment ratio	100		124.7
k	Tertiary gross enrolment ratio	100		79.6
	Normalized values	**Formula**	**Weight**	
	ICT access			
z1	Fixed-telephone subscriptions per 100 inhabitants	a/60	0.20	0.62
z2	Mobile-cellular telephone subscriptions per 100 inhabitants	b/120	0.20	1.00
z3	International Internet bandwidth per Internet user	log(c)/5.90	0.20	0.92
z4	Percentage of households with a computer	d/100	0.20	0.93
z5	Percentage of households with Internet access	e/100	0.20	0.93
	ICT use			
z6	Percentage of individuals using the Internet	f/100	0.33	0.95
z7	Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	g/60	0.33	0.67
z8	Wireless-broadband subscriptions per 100 inhabitants	h/100	0.33	1.00
	ICT skills			
z9	Adult literary rate	i/100	0.33	1.00
z10	Secondary gross enrolment ratio	j/100	0.33	0.80
z11	Tertiary gross enrolment ratio	k/100	0.33	0.99
	Sub-indices	**Formula**	**Weight**	
	ICT access sub-index (L)	**y1+y2+y3+y4+y5**	**0.40**	**0.88**
y1	Fixed-telephone subsriptions per 100 inhabitants	z1*.20		0.12
y2	Mobile-cellular telephone subscriptions per 100 inhabitants	z2*.20		0.20
y3	International Internet bandwidth per Internet user	z3*.20		0.18
y4	Percentage of households with a computer	z4*.20		0.19
y5	Percentage of households with Internet access	z5*.20		0.19
	ICT use sub-index (M)	**y6+y7+y8**	**0.40**	**0.87**
y6	Percentage of individuals using the Internet	z6*.33		0.32
y7	Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	z7*.33		0.22
y8	Wireless-broadband subscriptions per 100 inhabitants	z8*.33		0.33
	ICT skills sub-index (N)	**y9+y10+y11**	**0.20**	**0.93**
y9	Adult literary rate	z9*.33		0.33
y10	Secondary gross enrolment ratio	z10*.33		0.27
y11	Tertiary gross enrolment ratio	z11*.33		0.33
IDI	**ICT Development Index**	**((L*.40)+(M*.40)+(N*.20))*10**		**8.86**

Note: *The ideal value for indicators a, b, c and g was computed by adding two standard deviations to the mean value of the indicator.
** To diminish the effect of the large number of outliers at the high end of the value scale, the data were first transformed to a logarithmic (log) scale. The ideal value of 787’260 bit/s per Internet user is equivalent to 5.90 if transformed to a log scale.

Source: ITU.

Potential sources of variation or uncertainty can be attributed to different processes employed in the computation of the index, including the selection of individual indicators, the imputation of missing values and the normalization, weighting and aggregation of the data.

Each of the processes or combination of processes affects the IDI value. A number of tests were carried out to examine the robustness of the IDI results (rather than the actual values). The tests computed the possible index values and country rankings for different combinations of the processes mentioned above. Results show that, while the computed index values change, the message remains the same. The IDI was found to be extremely robust to different methodologies – with the exception of some countries, particularly countries in the "high" group.

The relative position of countries included in the "high" group (see Chapter 2) can change depending on the methodology used. Therefore, caution should be exercised when drawing conclusions based on the ranking of these countries. However, the relative position of countries included in the "low" group is in no way affected by the methods or techniques used, and the countries in this group ranked low in all index computations using different methodologies. This confirms the results conveyed by the IDI.

Endnotes

1 Principal component analysis was used to examine the underlying nature of the data. A more detailed description of the analysis is available in the Annex 1 to the 2009 'Measuring the Information Society. The ICT Development Index' report (ITU, 2009).

2 More information about the indicators is available in the ITU 'Handbook for the collection of administrative data on telecommunications/ICT' 2011, see ITU 2011 and the ITU "Manual for Measuring ICT Access and Use by Households and Individuals", see ITU 2014.

3 This definition reflects the revisions agreed upon by the ITU Expert Group on ICT Household Indicators (EGH) at its meeting in Sao Paulo, Brazil, on 4-6 June 2013, see http://www.itu.int/en/ITU-D/Statistics/Documents/events/brazil2013/Final_report_EGH.pdf). As some of the data used in the calculation of the IDI were collected before that meeting, however, the data may not necessarily reflect these revisions.

4 More information about the indicators is available in the ITU "Handbook for the collection of administrative data on telecommunications/ICT"' 2011, see ITU 2011b and the ITU "Manual for Measuring ICT Access and Use by Households and Individuals", see ITU 2014.

5 UIS 'Education Indicators: Technical Guidelines', see http://www.uis.unesco.org/ev.php?ID=5202_201&ID2=DO_TOPIC.

6 See OECD and European Commission (2008).

7 For more details, see Annex 1 to ITU (2009).

Annex 2. ICT price data methodology

1. Price data collection and sources

The price data presented in this report were collected in the fourth quarter of 2013. The data were collected through the ITU *ICT Price Basket questionnaire*, which was sent to the administrations and statistical contacts of all 193 ITU Member States in October 2013. Through the questionnaire, contacts were requested to provide 2013 data for fixed-telephone, mobile-cellular, fixed-broadband and mobile-broadband prices; the 2011 and 2012 prices were included for reference, where available. For those countries that did not reply, prices were collected directly from operators' websites and/or through direct correspondence. Prices were collected from the operator with the largest market share, as measured by the number of subscriptions. Insofar as, for many countries, it is not clear which Internet service provider (ISP) has the dominant market share, preference was given to prices offered by the (former) incumbent telecommunication operator. In some cases, especially when prices were not clearly advertised or were described only in the local language, and when operators did not respond to queries, alternative operators were chosen. All prices were converted into USD using the IMF's average annual rate of exchange for 2013 and into PPP$ using World Bank conversion factors. Prices are also presented as a percentage of countries' monthly GNI per capita using GNI p.c. values from the World Bank (Atlas method) for 2013 or the latest available year adjusted with the international inflation rates. Prices for 2008, 2009, 2010, 2011 and 2012, which are also shown and used in this chapter, were collected in previous years (always during the second half of the respective year), in national currencies, and converted using the average annual rates of exchange.

2. The ICT Price Basket (IPB)

The ICT Price Basket (IPB) is a composite basket that includes three price sets, referred to as sub-baskets: the fixed-telephone, mobile-cellular and fixed-broadband sub-baskets. The IPB is the value calculated from the sum of the price of each sub-basket (in USD) as a percentage of a country's monthly GNI per capita, divided by three. The collection of price data from ITU Member States and the methodology applied for the IPB was agreed upon by the ITU Expert Group on Telecommunication/ICT Indicators (EGTI)[1] and endorsed by the eighth World Telecommunication/ICT Indicators meeting held in November 2010 in Geneva, Switzerland.

The fixed-telephone sub-basket

The fixed-telephone sub-basket refers to the monthly price charged for subscribing to the public switched telephone network (PSTN), plus the cost of 30 three-minute local calls to the same (fixed) network (15 peak and 15 off-peak calls). It is calculated as a percentage of a country's average monthly GNI per capita, and also presented in USD and PPP$.

The fixed-telephone sub-basket does not take into consideration the one-time connection charge. This choice has been made in order to improve comparability with the other sub-baskets, which include only recurring monthly charges. If the monthly subscription includes free calls/minutes, then these are taken into consideration and deducted from the total cost of the fixed-telephone sub-basket.

The cost of a three-minute local call refers to the cost of a three-minute call within the same exchange area (local call) using the subscriber's equipment (i.e. not from a public telephone). It thus refers to the amount the subscriber must pay for a three-minute call and not the average price for each three-minute interval. For example, some operators charge a one-time connection fee for every call or a different price for the first minute of a call. In such cases, the actual amount for the first three minutes of a call is calculated. Many operators indicate whether advertised prices include taxes or not. If they are not included, taxes are added to the prices, so as to improve the comparability between countries.[2] The sub-basket does not take into consideration the price of a telephone set (see Annex Box 2.1).

The ICT Price Basket includes a sub-basket for fixed telephony because fixed-telephone access remains an important access technology in its own right in a large number of countries. Additionally, the conventional fixed-telephone line is used not only for dial-up Internet access, but also as a basis for upgrading to DSL broadband technology, which in 2013 still accounted for the majority of all fixed-broadband subscriptions. While more and more countries are moving away from narrowband/dial-up Internet access to broadband, dial-up Internet access still remains the only Internet access available to some people in developing countries. Since the IPB does not include dial-up (but only broadband) Internet prices, and since dial-up Internet access requires users to subscribe to a fixed-telephone line, the fixed-telephone sub-basket can be considered as an indication for the price of dial-up Internet access.

The mobile-cellular sub-basket

The mobile-cellular sub-basket refers to the price of a standard basket of mobile monthly usage for 30 outgoing calls per month (on-net, off-net to a fixed line and for peak and off-peak times) in predetermined ratios, plus 100 SMS messages. It is calculated as a percentage of a country's average monthly GNI per capita, and also presented in USD and PPP$. The mobile-cellular sub-basket is based on prepaid prices, although postpaid prices are used for countries where prepaid subscriptions make up less than 2 per cent of all mobile-cellular subscriptions.

The mobile-cellular sub-basket is largely based on, but does not entirely follow, the 2009 methodology of the OECD low-user basket, which is the entry-level basket with the smallest number of calls included (OECD, 2010b). Unlike the 2009 OECD methodology, which is based on the prices of the two largest mobile operators, the ITU mobile sub-basket uses only the largest mobile operator's prices. Additionally, the ITU mobile-cellular sub-basket does not take into account calls to voicemail (which in the OECD basket represent 4 per cent of all calls), nor non-recurring charges, such as the one-time charge for a SIM card. The basket gives the price of a standard basket of mobile monthly usage in USD determined by OECD for 30 outgoing calls per month in predetermined ratios plus 100 SMS messages.[4] The cost of national SMS is the charge to the consumer for sending a single SMS text message. Both on-net and off-net SMS prices are taken into account. The basket considers on-net and off-net calls as well as calls to a fixed telephone[5] and, since the price of a call often depends on the time of day or week it is made, peak, off-peak and weekend periods are also taken into consideration. The call distribution is outlined in Table Annex 2.1.

Annex Box 2.1: Rules applied in collecting fixed-telephone prices

1. The prices of the operator with the largest market share (measured by the number of fixed-telephone subscriptions) should be used.
2. Prices should be collected in national currency, including taxes.[3]
3. Only residential, single user prices should be collected. If prices vary between different regions of the country, the prices applying to the largest city (in terms of the population) should be provided. If that information is not available, the prices applying to the capital city should be reported. The selected city should be mentioned in a note in the monthly subscription indicator.
4. From all fixed-telephone plans meeting the above-mentioned criteria, the cheapest postpaid plan on the basis of 30 local calls (15 peak and 15 off-peak) of three minutes each should be selected. If there is a price distinction between residential and business tariffs, the residential tariff should be used.. If prices vary between different regions of the country, prices refer to those applied in the largest city (in terms of population). If that informtion is not available, the prices applying to the capital city are used.
5. In case operators propose different commitment periods, the 12-month plan (or the one closest to this commitment period) should be used. If the plan selected requires a longer commitment (i.e. above 12 months), this should be indicated in a note.
6. The same price plan should be used for collecting all the data specified. For example, if a given Plan A is selected for the fixed-telephone service, according to the criteria mentioned above, the elements in Plan A apply to the monthly subscription, and to the price per minute (peak and off-peak).
7. Prices should be collected for a regular (non-promotional) plan and should not include promotional offers or limited or restricted discounts (for example, only to students, or to existing customers, etc.).
8. Local calls refer to those made on the same fixed network (on-net) within the same exchange area.
9. Peak is the busiest time of the day, usually during working hours of weekdays. If there are different peak prices, the most expensive one during the daytime should be selected.
10. If there are different off-peak prices, then the one that is the cheapest before midnight should be used. If the only off-peak period is after midnight (valid during the night), then this should not be used. Instead, use the peak rate.
11. If no distinction is made between peak and off-peak prices, then the same price should be used for the peak and off-peak indicators.
12. For plans that include a certain number of minutes, the price advertised per additional minute should be used to calculate the price of a three-minute local call (i.e. the price per minute is not calculated based on the number of minutes included in the monthly subscription).
13. When the price per minute is not available, but rather per 'units' of a certain number of minutes are charged, the price per three minutes should be calculated and a note should be added, indicating the price per unit and the number of minutes included in the unit. For example, if the price is given per 'units' of two minutes, then the price for three minutes should be 2 times the price per 'unit'.
14. With convergence, operators are increasingly providing multiple (bundled) services, such as voice telephony, Internet access and television reception, over their networks. They often bundle these offers into a single subscription. This can present a challenge for data collection, since it may not be possible to isolate the prices for one service. It is preferable to use prices for a specific service; but if this is not possible, then the additional services that are included in the price are specified in a note.

Source: ITU.

Prepaid prices were chosen because they are often the only payment method available to low-income users, who might not have a regular income and will thus not qualify for a postpaid subscription. Rather than reflecting the cheapest option available, the mobile-cellular sub-basket therefore corresponds to a basic, representative (low-usage) package

Annex Table 2.1: OECD mobile-cellular low-user call distribution (2009 methodology)

	To fixed	On-net	Off-net	TOTAL	Call distribution by time of day (%)
Call distribution (%)	17.0	56.0	26.0	100.0	100.0
Calls	5.2	16.9	7.9	30.0	
Peak	2.4	7.8	3.6	13.8	46.0
Off-peak	1.5	4.9	2.3	8.7	29.0
Weekend	1.3	4.2	2.0	7.5	25.0
Duration (minutes per call)	2.0	1.6	1.7		
Duration (total minutes of calls)	10.4	27.0	13.4	50.9	N/A
Peak	4.8	12.4	6.2	23.4	46.0
Off-peak	3.0	7.8	3.9	14.8	29.0
Weekend	2.6	6.8	3.4	12.7	25.0
Calls	30 calls per month				
SMS	100 SMS per month (50 on-net, 50 off-net)				

Note: N/A: Not applicable.
Source: ITU, based on OECD (2010b).

available to all customers. In countries where no prepaid offers are available, the monthly fixed cost (minus the free minutes of calls included, if applicable) of a postpaid subscription is added to the basket. To make prices comparable, a number of rules are applied (see Annex Box 2.2).

The fixed-broadband sub-basket

The fixed-broadband sub-basket refers to the price of a monthly subscription to an entry-level fixed-broadband plan. It is calculated as a percentage of a country's average monthly GNI per capita, and also presented in USD and PPP$. For comparability reasons, the fixed-broadband sub-basket is based on a monthly data usage of (a minimum of) 1 Gigabyte (GB). For plans that limit the monthly amount of data transferred by including data volume caps below 1 GB, the cost for the additional bytes is added to the sub-basket. The minimum speed of a broadband connection is 256 kbit/s.

Annex Box 2.2: Rules applied in collecting mobile-cellular prices

1. The prices of the operator with the largest market share (measured by the number of subscriptions) should be used. If prices vary between different regions of the country, the prices refer to those applied in the largest city (in terms of population) or in the capital city.
2. Prices should be collected in national currency, including taxes.[6]
3. Prices refer to prepaid plans. Where the operator offers different packages with a certain number of calls and/or SMS messages included, the one that comes closest to the 30 calls and 100 SMS included is used. In countries where prepaid subscriptions account for less than 2 per cent of the total subscription base, postpaid prices may be used. In this case, the monthly subscription fee, plus any free minutes, will be taken into consideration for the calculation of the mobile-cellular sub-basket.
4. If per-minute prices are only advertised in internal units rather than in national currency, the price of the top-up/refill charge is used to convert internal units into national currency. If there are different refill prices, then the 'cheapest/smallest' refill card is used. If different refill charges exist depending on the validity period, the validity period for 30 days (or closest to 30 days) is used.
5. Prices refer to a regular (non-promotional) plan and exclude special or promotional offers, limited discounts or options such as special prices to certain numbers, or plans where calls can only be made during a limited number of (or on specific) days during the month.
6. If subscribers can chose "favourite" numbers (for family, friends, etc.) with a special price, this special price will not be taken into consideration, irrespective of the quantity of numbers involved.
7. Prices refer to outgoing local calls. If different rates apply for local and national calls, then the local rate is used. If charges apply to incoming calls, these are not taken into consideration.
8. If prices vary between minutes (1st minute = price A, 2nd minute = price B, 3rd minute = price C), the sum of the different prices is divided by the number of different prices (for example: price per minute = (A+B+C)/3).
9. If prices vary beyond three minutes, the average price per minute is calculated based on the first three minutes.
10. If there is a connection cost per call, then this is taken into consideration in the formula for the mobile-cellular sub-basket, based on 30 calls.
11. If there are different off-peak prices, then the one that is the cheapest before midnight is used. If the only off-peak period is after midnight, then this is not used. Instead, the peak price is used.
12. If there are different peak prices, the most expensive one during the daytime is used.
13. If there are different weekend prices, the price that applies Sundays during the daytime is used (or the equivalent day in countries where weekends are not on Sundays).
14. If there is no weekend price, the average peak and off-peak price that is valid during the week is used.
15. If peak and off-peak SMS prices exist, the average of both is used for on-net and off-net SMS.
16. If calls are charged by call or by hour (and not by the minute), the mobile-cellular sub-basket formula will be calculated on the basis of 30 calls or 50.9 minutes. Similarly, if calls are charged by call or by number of minutes for a specific network/time of the day, this will be taken into account for that particular network/time of the day.
17. Where monthly, recurring charges exist, they are added to the sub-basket.

Source: ITU.

Annex Box 2.3: Rules applied in collecting fixed-broadband Internet prices

1. The prices of the operator with the largest market share (measured by the number of subscriptions) should be used.
2. Prices should be collected in national currency, including taxes.[7]
3. Only residential, single-user prices are collected. If prices vary between different regions of the country, the prices applying to the largest city (in terms of the population) should be provided. If that information is not available, the prices applying to the capital city are reported. The selected city should be mentioned in a note in the monthly subscription indicator.
4. From all fixed-broadband plans meeting the above-mentioned criteria, the cheapest one on the basis of a 1 GB monthly usage and an advertised download speed of at least 256 kbit/s should be selected. If there is a price distinction between residential and business tariffs, the residential tariff should be used.
5. In case operators propose different commitment periods, the 12-month plan (or the one closest to this commitment period) should be used. If the plan selected requires a longer commitment (i.e. above 12 months), this should be indicated in a note in the monthly subscription indicator. Furthermore, if there are different prices (for example, a discounted price for the first year, and a higher price as of the 13th month), then the price after the discount period should be selected (e.g. the price as of the 13th month). The discounted price charged during the initial period should be indicated in a note under the monthly subscription charge. The reason is that the initial price paid is considered a limited/discounted price, while the other is the regular price.
6. Prices should be collected for the fixed (wired)-broadband technology with the greatest number of subscriptions in the country (DSL, cable, etc.).
7. The same price plan should be used for collecting all the data specified. For example, if a given Plan A is selected for the fixed-broadband service, according to the criteria mentioned above, the elements in Plan A apply to the monthly subscription, the price of the excess charge, the volume of data that can be downloaded, etc.
8. Prices should be collected for regular (non-promotional) plan and should not include promotional offers or limited or restricted discounts (for example, only to students, or to existing customers, etc.).
9. With convergence, operators are increasingly providing multiple (bundled) services such as voice telephony, Internet access and television reception over their networks. They often bundle these offers into a single subscription. This can present a challenge for price data collection, since it may not be possible to isolate the prices for one service. It is preferable to use prices for a specific service (i.e. unbundled); if this is not possible, then the additional services that are included in the price plan should be specified in a note.
10. The cost of a fixed-telephone line should be excluded, if it can be used for other services as well. If a monthly rental for the physical line is not required (e.g. naked DSL), this should be mentioned in a note. If a monthly rental of a fixed-telephone line is required, this should also be explained in a note.

Source: ITU.

Where several offers are available, preference is given to the cheapest available connection that offers a speed of at least 256 kbit/s and 1 GB of data volume. If providers set a limit of less than 1 GB on the amount of data that can be transferred within a month, then the price per additional byte is added to the monthly price so as to calculate the cost of 1 GB of data per month. Preference should be given to the most widely used fixed (wired)-broadband technology (DSL, cable, etc.). The sub-basket does not include installation charges, modem prices or telephone-line rentals that are often required for a DSL service. The price represents the broadband entry plan in terms of the minimum speed of 256 kbit/s, but does not take into account special offers that are limited in time or to specific geographic areas. The plan does not necessarily represent the fastest or most cost-effective connection since often the price for a higher-speed plan is cheaper in relative terms (i.e. in terms of the price per Mbit/s) (see Annex Box 2.3).

3. Mobile-broadband prices

In 2012, for the first time, ITU collected mobile-broadband prices through its annual ICT Price Basket Questionnaire.[8] The collection of mobile-broadband price data from ITU Member States was agreed upon by the ITU Expert Group on Telecommunication/ICT Indicators (EGTI)[9] in 2012, and revised in 2013 by EGTI in view of the lessons learned from the first data collection exercise. The revised methodology was endorsed by the eleventh World Telecommunication/ICT Indicators Symposium held in December 2013 in Mexico City, Mexico.

To capture the price of different data packages, covering prepaid and postpaid services, and supported by different devices (handset and computer), mobile-broadband prices were collected for two different data thresholds, based on a set of rules (see Annex Box 2.4).

For plans that were limited in terms of validity (less than 30 days), the price of the additional days was calculated and added to the base package in order to obtain the final price. Two possibilities exist, depending on the operator, for extending a plan limited in terms of data allowance (or validity). The customer: (i) continues to use the service and pays an excess usage charge for additional data[10] or (ii) purchases an additional (add-on) package. Thus, for some countries, prices presented in this chapter reflect calculated prices of the base package plus an excess usage charge (e.g. a base package including 400 MB plus the price for 100 MB of excess usage for a monthly usage of 500 MB), or a multiplication of the base package price (e.g. twice the price of a 250 MB plan for a monthly usage of 500 MB).

The plans selected represent the least expensive offers that include the minimum amount of data for each respective mobile-broadband plan. The guiding idea is to base each plan on what customers would and could purchase given the data allowance and validity of each respective plan.

Annex Box 2.4: Rules applied in collecting mobile-broadband prices[11]

1. Prices should be collected based on one of the following technologies: UMTS, HSDPA+/HSDPA, CDMA2000, and IEEE 802.16e. Prices applying to WiFi or hotspots should be excluded.
2. Prices should be collected in national currency, including taxes.
3. Only residential, single-user prices should be collected. If prices vary between different regions of the country, the prices applying to the largest city (in terms of population) or to the capital city should be provided.
4. Prices should be collected for both: a) handset-based mobile-broadband subscriptions and b) computer-based mobile-broadband subscriptions.
5. Mobile-broadband prices should be collected from the operator with the largest market share in the country, measured by the number of mobile-broadband subscriptions. If this information is not available, mobile-broadband prices should be collected from the mobile-cellular operator with the largest market share (measured by the number of mobile-cellular subscriptions) in the country.
6. Different operators can be chosen, for a different mobile-broadband service, if: a) there are differing market leaders for specific segments (postpaid, prepaid, computer-based, handset-based); b) there is no offer available for a specific sub-basket.
7. Prices should be collected for prepaid and postpaid services, for both handset and computer-based plans. If there are several plans, the plan satisfying the indicated data volume requirement should be used.
8. Where operators propose different commitment periods for postpaid mobile-broadband plans, the 12-month plan (or the closest to this commitment period) should be selected. A note should be added in case only longer commitment periods are offered.
9. Price data should be collected for the cheapest plan with a data volume allowance of a minimum of:
   i. 1 GB for USB/dongle (computer-based) subscriptions
   ii. 500 MB for handset-based subscriptions.

   The selected plan should not be the one with the cap closest to 500 MB or 1 GB, but include a minimum of 500 MB/1 GB.
   This means, for example, if an operator offers a 300 MB and an 800 MB plan, the 800 MB plan or twice the 300 MB plan (if the package can be purchased twice for a monthly capacity of 600 MB) should be selected for the 500 MB sub-sub-basket. The cheapest option should be selected. Data volumes should refer to both upload and download data volumes. If prices are linked to 'hours of use' and not to data volumes, this information should be added in a separate note.
   Note: ITU will most likely not be able to include these cases in a comparison.
10. A validity period of 30 days should be chosen. If this is not available, 15 days should be used. Offers with a validity of one day should be excluded.
11. Preference should be given to packages (including a certain data volume). Pay-as-you-go offers should be used when they are the cheapest option for a given basket or the only option available. If operators charge different pay-as-you-go rates depending on the time of the day (peak/off-peak), then the average of both should be recorded. If the off-peak rate is after midnight, it will not be taken into account.
12. Even if the plan is advertised as 'unlimited', the fine print should be carefully read since most often there are limits in the data volumes, either applied by throttling (limiting the speed) or by cutting the service.
13. Non-recurrent fees, such as installation/set-up fees are not collected.
14. Preference should be given to packages that are not bundled (with voice services, for example). If the plan chosen includes other services besides mobile-broadband access, these should be specified in a note.
15. Prices refer to a regular (non-promotional) plan and exclude promotional offers and limited discounts or special user groups (for example, existing clients). Special prices that apply to a certain type of phone (iPhone/Blackberry, iPad) should be excluded. Allowances during the night are not included..

Source: ITU.

Endnotes

[1] The Expert Group on Telecommunication/ICT Indicators (EGTI) was created in May 2009 with the mandate to revise the list of ITU supply-side indicators (i.e. data collected from operators), as well as to discuss outstanding methodological issues and new indicators. EGTI is open to all ITU members and experts in the field of ICT statistics and data collection. It works through an online discussion forum (http://www.itu.int/ITU-D/ict/ExpertGroup/default.asp) and face-to-face meetings. EGTI reports to the World Telecommunication/ICT Indicators Symposium (WTIS).

[2] In some cases, it is not clear whether taxes are included or not and it was not possible to obtain this information from country contacts or operators; in such cases, the advertised price is used.

[3] In some cases, it is not clear whether taxes are included or not and it was not possible to obtain this information from country contacts or operators; in such cases, the advertised price is used.

[4] See OECD (2010b).

[5] On-net refers to a call made to the same mobile network, while off-net and fixed-line refer to calls made to other (competing) mobile networks and to a fixed-telephone line, respectively.

[6] In some cases, it is not clear whether taxes are included or not and it was not possible to obtain this information from country contacts or operators; in such cases, the advertised price is used.

[7] In some cases, it is not clear whether taxes are included or not and it was not possible to obtain this information from country contacts or operators; in such cases, the advertised price is used.

[8] Data for fixed-telephone, mobile-cellular and fixed-broadband have been collected since 2008 through the ITU ICT Price Basket Questionnaire, which is sent out annually to all ITU Member States/national statistical contacts.

[9] See footnote 1.

[10] Some operators throttle speeds after the data allowance included in the base package has been reached. Customers can then pay an excess usage charge in order to continue to have full-speed connections. In some cases, even throttled speeds are still considered broadband (i.e. equal to, or greater than, 256 kbit/s according to ITU's definition).

[11] These rules were presented to the Expert Group on Telecommunication/ICT Indicators (EGTI) in September 2012. In the 2013 revision, EGTI agreed that ITU should collect prepaid and postpaid prices, for both handset- and computer-based services, with the following volume allowances: 1 GB for computer-based and 500 MB for handset-based usage. The EGTI proposals to measure mobile-broadband prices were endorsed by the eleventh World Telecommunication/ICT Indicators Symposium held in December 2013 in Mexico City, Mexico.

Annex 3. Statistical tables of indicators used to compute the IDI

Access indicators

	Economy	Fixed-telephone subscriptions per 100 inhabitants 2012	Fixed-telephone subscriptions per 100 inhabitants 2013	Mobile-cellular subscriptions per 100 inhabitants 2012	Mobile-cellular subscriptions per 100 inhabitants 2013	International Internet bandwidth Bit/s per Internet user 2012	International Internet bandwidth Bit/s per Internet user 2013	Percentage of households with computer 2012	Percentage of households with computer 2013	Percentage of households with Internet access 2012	Percentage of households with Internet access 2013
1	Afghanistan	0.3	0.3	65.5	70.0	1’229	2’774	2.3	2.5	1.9	2.1
2	Albania	9.9	8.9	110.7	116.2	17'358	20'974	20.0	21.7	20.5	24.5
3	Algeria	8.4 [1]	8.0 [1]	97.5	102.0	17'824	26'275	24.2	26.0	19.4	23.8
4	Andorra	48.9	48.7	81.5	80.7	38'388	80'575	83.2	82.2	74.3	78.0
5	Angola	1.0	1.0	61.4	61.9	2'303	1'980	8.5	9.2	7.2	7.9
6	Antigua & Barbuda	37.2	36.8	143.0 [1]	127.1	97'620	108'237	56.1	56.1	48.2	48.2
7	Argentina	23.0	23.3	156.6	159.0 [1]	36'203	44'308	56.0	59.2	47.5	53.9
8	Armenia	19.7	19.4	111.9	112.4	40'374	55'146	38.9	40.1	34.5	35.6
9	Australia	45.4 [2]	44.3 [2]	105.6 [2]	106.8	60'407	67'099	83.0	83.5	79.0	83.0
10	Austria	39.9 [3]	39.4 [3]	160.5	156.2	95'959	128'492	81.3	80.9	79.3	80.9
11	Azerbaijan	18.5 [4]	18.7 [4]	108.8	107.6	39'640	45'243	45.0	52.0	46.8	51.5
12	Bahrain	22.7	21.8	161.2	165.9	18'108	25'856	92.7 [1]	93.0	79.0 [1]	82.0
13	Bangladesh	0.6	0.7	62.8	67.1	3'322	3'984	4.8	5.8 [1]	3.2	4.6 [1]
14	Barbados	50.6	52.3	123.3	108.1	39'844	52'042	69.2	69.1	62.9	66.7
15	Belarus	46.9	47.8	113.5	118.8	79'330	94'797	51.7	54.9	48.3	51.9
16	Belgium	41.9	41.3 [5]	111.3 [3]	110.9 [2]	183'250	201'873	80.3	81.9	77.7	80.0
17	Benin	1.6	1.5	83.7	93.3	2'399	3'153	4.2	4.5	2.4	2.9
18	Bhutan	3.6 [5]	3.5 [6]	75.6 [4]	72.2 [3]	3'287	2'750	16.4	19.1	11.6	15.5
19	Bolivia	8.4	8.2	90.4 [5]	97.7 [4]	4'985	9'009 [1]	29.5 [2]	31.7	10.7 [2]	11.5
20	Bosnia and Herzegovina	23.1	23.2	87.6	91.2	23'945	30'768	39.8	43.0	39.7	47.5
21	Botswana	8.0 [6]	8.6 [7]	153.8 [6]	160.6 [5]	6'509	6'597	12.3	13.5	9.1	10.6
22	Brazil	22.3	22.3	125.0	135.3	46'026 [1]	42'946 [2]	45.8	48.8	39.6	42.4
23	Brunei Darussalam	17.2	13.6	113.9	112.2	39'925 [2]	48'243	86.9	90.6	72.4	75.8
24	Bulgaria	29.3	26.9 [7]	148.1	145.2 [6]	90'770	107'238	52.3	54.9	50.9	53.7
25	Burkina Faso	0.9	0.8	60.6	66.4	1'812	3'150	3.4	4.0	2.8	3.2
26	Cambodia	3.9 [7]	2.8	128.5	133.9	13'618	9'301	6.3	9.3 [2]	2.1	5.5
27	Cameroon	3.4	3.6	60.4	70.4	2'863	3'166	8.3	8.9	3.5	4.5
28	Canada	50.7 [8]	49.7	80.1	78.4	105'065	115'948	84.1	83.6	81.5	82.6
29	Cape Verde	14.2	13.3	86.0	100.1	6'317 [3]	11'599	29.3	30.2	20.3	22.8
30	Central African Rep.	0.0 [9]	0.0	25.3 [7]	29.5	162	136	2.9	2.9	2.4	2.4
31	Chad	0.2	0.2	35.4	35.6	513	631	2.5	2.5	2.3	2.3
32	Chile	18.8	18.2	137.1	134.3	40'460	56'328	53.7	57.0	45.3	49.6
33	China	20.2	19.3	80.8	88.7	3'261	4'230	40.9	43.8	37.4	43.9
34	Colombia	15.0	14.8	102.9	104.1	20'372 [4]	76'054 [3]	38.4 [3]	42.2 [3]	32.1	35.7 [2]
35	Congo	0.3	0.4 [5]	98.8	104.8	204	184	4.3	4.6	1.3	1.6
36	Congo (Dem. Rep.)	0.1	0.0	30.6	43.7	725	539 [4]	1.3	1.6	1.3	1.6
37	Costa Rica	20.7	19.9 [5]	111.9	146.0 [7]	62'735 [5]	73'491 [5]	49.0 [4]	51.0 [4]	47.3 [3]	46.7 [3]
38	Côte d'Ivoire	1.4	1.3	91.2	95.4	16'950	22'718	2.3	2.3	1.3	1.5
39	Croatia	37.9	36.8	115.4	114.5	37'481	40'513	68.0	66.3	66.4	64.6
40	Cuba	10.8	11.0	14.9	17.7	158	405	11.3	12.7	3.8	3.4
41	Cyprus	33.1	30.6	98.4	95.2	70'054	63'378	69.7	70.3	61.8	64.7
42	Czech Republic	19.9 [10]	18.7 [5]	126.8	131.3 [7]	102'201	111'203	67.3	73.9	65.4	72.6
43	Denmark	41.1	37.4	130.3	127.5	176'203	261'221	92.3	93.1	92.0	92.7
44	Djibouti	2.3	2.4	24.7	28.0	11'960	10'250	15.5	16.8	5.1	6.1
45	Dominica	22.7	23.8	152.5	130.0	65'734	61'203 [5]	36.0	37.0	34.0	35.0
46	Dominican Rep.	11.0 [4]	11.3 [4]	86.9	88.4	16'281	16'944 [6]	22.1	24.5	14.4	18.6
47	Ecuador	14.9 [11]	15.2	106.2	111.5	31'804 [5]	29'767 [1]	32.2	35.7	22.5	28.3
48	Egypt	10.6	8.3	119.9	121.5	4'249	5'284	37.9	43.1	32.3	34.5
49	El Salvador	16.8	15.0	137.3	136.2	16'017	40'488	19.6	22.3	11.8	12.7
50	Eritrea	1.0	1.0	5.0	5.6	1'284	1'579	1.5	1.9	1.1	1.3
51	Estonia	34.7	33.1	160.4 [8]	159.7	26'684	29'130	75.5	80.0	75.0	80.3
52	Ethiopia	0.9	0.8	22.4	27.3	4'779	6'712	2.1	2.1	1.9	2.3
53	Fiji	10.1	8.5	98.2	101.1	9'232 [6]	14'299 [2]	31.7	34.2	24.4	26.7
54	Finland	16.4	13.9	172.3	171.7 [8]	161'279	172'175	87.6	88.7	86.8	89.2
55	France	62.1	60.8	97.4	98.5	85'525	141'511	81.0	81.6	80.0	81.7
56	Gabon	1.4	1.2	179.5	214.8	14'217	18'056	10.1	11.3	7.9	8.8
57	Gambia	3.6	3.5	85.2	100.0	2'117	7'184	7.4	7.4	6.7	7.6
58	Georgia	29.3 [12]	27.7	107.8	115.0	65'220	82'094	32.7	39.6	27.3	34.6
59	Germany	60.5 [13]	58.9 [5]	111.6 [9]	119.0 [9]	90'928	112'369	87.1	88.9	85.5	87.7
60	Ghana	1.1	1.0	101.0	108.2	3'668	5'207	36.6 [5]	36.6 [5]	31.8 [4]	31.8 [4]
61	Greece	49.1	47.9	120.1	116.8	65'292 [7]	84'810	56.8	59.5	53.6	56.3
62	Grenada	26.3	27.0	123.2	125.6	142'203	188'863	37.0	38.0	30.0	31.0
63	Guatemala	11.6	12.0	137.8	140.4	10'359	10'829	19.2	19.7	9.3	9.3
64	Guinea	0.0	0.0	48.8	63.3	2'051	2'490	2.1	2.1	1.3	1.4
65	Guinea-Bissau	0.3	0.3	63.1	74.1	3'220	2'934	2.3	2.3	1.6	1.8
66	Guyana	19.4	19.6	68.8	69.4	8'382	10'232	22.9	22.9	20.6	20.6
67	Honduras	7.7	7.6	92.9 [10]	95.9	4'868	9'954 [7]	15.1	20.1	13.2	16.4
68	Hong Kong, China	61.3	63.0	229.2	238.7	1'424'597 [8]	1'762'774 [8]	80.0 [6]	81.9	77.9 [5]	79.9 [5]
69	Hungary	29.7	29.9	116.1	116.4	15'622	24'891	71.4	73.1	68.6	71.5
70	Iceland	55.2	51.0	108.1	108.1	318'963	443'180	95.5	96.7	94.6	96.4
71	India	2.5 [14]	2.3 [8]	69.9 [11]	70.8 [10]	4'464 [6]	6'782 [9]	10.9	11.9	9.5	13.0
72	Indonesia	15.4	16.1	114.2	121.5	9'645	10'119	14.9	15.6	6.1	5.7
73	Iran (I.R.)	37.6	38.3	76.1	84.2	3'528	4'632	37.0	44.6	32.3	35.8
74	Ireland	43.9 [15]	44.0 [9]	107.2	102.8	99'722	132'296	82.7	83.6	81.1	82.4
75	Israel	47.0	44.8 [10]	120.7	122.8	58'205	100'455	80.4	85.0	70.7	71.1
76	Italy	35.6 [16]	34.3 [11]	159.7 [12]	158.9	73'547	89'750	67.1	71.1	62.9	68.9
77	Jamaica	9.1	8.9	98.0 [13]	100.4	32'064	32'310	28.5	30.5	21.3	23.5
78	Japan	50.5 [17]	50.4 [12]	108.7 [14]	115.2 [11]	30'086	39'211	76.2	76.2	86.2 [6]	86.2
79	Jordan	6.2	5.2	128.2	141.8	5'219	4'044	54.6	58.7	43.6	44.9
80	Kazakhstan	26.8	26.7	185.8	180.5	32'028	49'839	63.0	63.0	52.6	55.0
81	Kenya	0.6	0.5	71.2	70.6	23'711	49'860	10.8	10.8	11.5	14.2
82	Korea (Rep.)	61.4	61.6	109.4	111.0	25'823	30'306	82.3	80.6	97.3	98.1
83	Kyrgyzstan	8.9	8.3	124.2	121.4 [12]	3’876	3’858	17.6	20.0	7.2	7.7

	Economy	Fixed-telephone subscriptions per 100 inhabitants		Mobile-cellular subscriptions per 100 inhabitants		International Internet bandwidth Bit/s per Internet user		Percentage of households with computer		Percentage of households with Internet access	
		2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
84	Lao P.D.R.	*6.8* [10]	10.0 [13]	64.7 [15]	66.2	9'397 [9]	*10'636*	*8.7*	*9.6*	*5.1*	*5.1*
85	Latvia	*24.3*	*23.4*	*112.1*	*136.6*	*59'738*	*68'069*	69.5	71.7	68.7	71.6
86	Lebanon	18.7	18.0	80.8	80.6	18'445 [10]	15’443	*79.7*	*87.9*	*64.0*	*66.2*
87	Lesotho	2.5	2.8	75.3	86.3	6'330	5'920	*5.9*	*6.4*	*3.7*	*4.3*
88	Liberia	0.0 [18]	*0.0*	57.1 [16]	59.5 [13]	2'006 [11]	6'809 [10]	*2.0*	*2.0*	*1.5*	*1.5*
89	Lithuania	22.3	20.7	165.1	151.3	77'065	99'634	63.6	65.9	61.6	64.7
90	Luxembourg	50.9 [19]	50.5 [14]	145.4	148.6	4'244'992 [12]	6'445'759 [11]	92.1	94.3	93.1	94.5
91	Macao, China	29.2 [20]	28.0 [15]	289.8	304.0	62'095 [13]	79'683 [12]	82.6	81.9	82.5	82.6
92	Madagascar	1.1	1.1	39.4	36.1	493	448	*2.9*	*3.7*	*2.7*	*3.7*
93	Malawi	1.4	0.2 [13]	29.2	32.3	2'803	2'196	4.0 [7]	*4.5*	5.5 [7]	*6.0*
94	Malaysia	15.7	15.3	141.3	144.7	16'424	22'139	66.9	65.1	64.7	64.7
95	Maldives	6.8	6.5	165.6	181.2	25'479	54'510	*67.2*	*71.9*	*34.3*	*39.4*
96	Mali	0.8	0.7	98.4	129.1	5'292	5'893	*7.7*	*9.3*	*2.5*	*3.0*
97	Malta	53.7	53.9	124.4	129.8	642'269	1'204'629	78.3	80.3	77.5	78.8
98	Mauritania	1.7 [21]	1.4 [16]	106.0 [17]	102.5 [14]	3'042	2'571	*3.7*	*4.0*	*3.4*	*4.3*
99	Mauritius	28.2	29.2	119.9	123.2	18'845	24'438	44.9	48.5	39.2	44.5
100	Mexico	17.0 [22]	16.8 [13]	83.4 [18]	85.8 [1]	15'146 [14]	*22'571*	32.2	35.8	26.0	30.7
101	Moldova	34.3	35.0	*102.0* [19]	*106.0* [15]	94'175	115'845	*44.5*	*49.5*	*42.0*	*46.0*
102	Monaco	121.7	123.8	88.3	93.7	244'695 [7]	233'150	*73.5*	*73.5*	*70.9*	*72.8*
103	Mongolia	6.3	6.2	120.7	124.2	94'295	59'708	30.3 [8]	*34.3*	14.0 [8]	*14.0*
104	Montenegro	*27.3*	*27.2*	*159.5*	*159.9*	*60'621*	*76'500*	51.3	*53.8*	55.0	*55.0*
105	Morocco	10.1	8.9	120.0	128.5	14'760	22'289	43.1	47.0	38.9	46.0
106	Mozambique	0.3	0.3	34.9	48.0	*2'046*	*2'867*	*5.9*	*6.7*	*4.7*	*4.6*
107	Myanmar	1.0	1.0	7.1	12.8	23'895	26'199	*2.3*	*2.8*	*1.8*	*2.2*
108	Namibia	7.6	8.0	95.0	110.2	3'564	3'398	*14.3*	*15.4*	*13.0*	*16.0*
109	Nepal	3.0	3.1 [17]	60.5 [6]	71.5 [16]	*1'632*	*2'434*	*7.8*	*7.8*	*4.1*	*4.9*
110	Netherlands	43.0	42.5 [18]	118.0	113.7 [17]	*193'291*	*234'975*	94.5	95.2	93.5	94.6
111	New Zealand	42.2	41.1	110.4 [20]	105.8 [18]	*33'907*	*45'578*	78.0	*77.3*	80.0	76.8 [6]
112	Nicaragua	5.0 [10]	5.3 [5]	97.7 [21]	112 [7]	*24'725*	32'595	*9.9*	*10.9*	*7.4*	*9.4*
113	Niger	0.6	*0.6*	31.4	*39.3*	3'499	*3'299*	*1.8*	*2.1*	*1.4*	*1.8*
114	Nigeria	0.2 [23]	0.2 [19]	66.8	73.3	*451*	*758*	7.1	8.4	6.3	7.8
115	Norway	28.0	26.2 [20]	116.7	116.5 [19]	*158'673*	*195'901*	91.9	93.3	92.7	94.3
116	Oman	9.2	9.7	159.3	154.7	8'948	33'976	*72.0*	82.9 [6]	*59.8*	80.1
117	Pakistan	3.3	3.5	67.1	70.1	7'285	6'548	*12.5*	*14.1*	*8.3*	*8.3*
118	Palestine	9.3	9.3	74.3	73.7	11'159	*15'873*	*53.9*	*57.1*	*33.4*	*33.4*
119	Panama	15.0	15.2 [5]	163.4	163.0 [7]	55'169 [14]	54'291	37.1	*39.3*	30.5	*31.5*
120	Paraguay	6.1	5.9	101.6	103.7	10'691	12'663	29.5	31.8	25.1	26.6
121	Peru	11.4	11.3	98.0 [22]	98.1 [8]	*13'094*	*18'140*	29.9	32.0	20.2	22.1
122	Philippines	3.6	3.2	105.5	104.5	44'885	57'605	*16.9*	*18.7*	*18.9*	*22.9*
123	Poland	15.6 [24]	*13.9*	141.5	*150.0*	*54'601*	*73'026*	73.4	74.7	70.5	71.9
124	Portugal	43.0	42.7	114.0 [23]	113.0 [20]	*171'920*	*181'109*	66.1	66.7	61.0	62.3
125	Qatar	19.2 [10]	19.0 [21]	126.9 [3]	152.6 2	42'224 [7]	48'652 [5]	91.5	97.2	88.1	96.4
126	Romania	21.4	21.8	105.0 [24]	105.6 [21]	125'638	136'597	56.7	61.2	53.8	*58.1*
127	Russian Federation	29.5	28.5	145.3 [25]	152.8 [22]	27'420	41'246	67.0	69.7	59.1	67.2
128	Rwanda	0.4	0.4	49.7	56.8	6'585	9'754	*2.4*	*2.9*	*2.41*	*2.9*
129	Saudi Arabia	17.0	16.4 [22]	187.4	176.5 [23]	36'396	46'682	*67.7*	*72.6*	*66.6*	*72.7*
130	Senegal	2.5	2.4	83.6	92.9	5'122	5'417	*9.0*	*10.3*	*5.8*	*6.3*
131	Serbia	38.4	39.3	117.8 [26]	119.4	89'506	108'874	*60.3*	*62.7*	*48.0*	*48.0*
132	Seychelles	22.7	23.4	147.8	147.3	15'606	23'646	*51.9*	*59.3*	*41.9*	*50.6*
133	Singapore	37.5	36.4 [7]	152.1 [27]	155.6 [24]	405'306 [6]	580'727 [2]	85.0	86.0 [7]	84.0	86.0 [7]
134	Slovakia	17.9	17.7	111.9	113.9	11'969	11'779	78.8	80.1	75.4	77.9
135	Slovenia	40.1	38.2	108.4	110.2	*96'937*	*152'739*	76.1	76.4	73.9	75.6
136	Solomon Islands	1.5	1.4	55.0	57.6	3'614	4'822	*5.1*	*5.5*	*4.2*	*4.2*
137	South Africa	*9.3*	9.2	*130.6*	147.5	*3'445*	*3'720*	*23.6*	*25.8*	33.9 [9]	*39.4*
138	Spain	41.9	40.7 [23]	108.4	106.9 [25]	*73'531*	*102'422*	73.9	73.4	67.9	69.8
139	Sri Lanka	16.3 [6]	12.7 [24]	91.6	95.5	5'995 [15]	4'964 [13]	*15.0*	*16.4*	*10.3*	*12.7*
140	St. Kitts and Nevis	*37.3*	35.4 [5]	141.8	142.1 [7]	*117'596*	*115'333*	*54.7*	*59.6*	*58.0*	*60.0*
141	St. Lucia	20.4	18.4 [7]	119.4	116.3	*95'270*	*93'516*	36.0	37.2	34.7	34.9
142	St. Vincent and the Grenadines	17.7 [25]	17.4	116.1	114.6	577'211 [16]	527'482 [14]	*62.3*	*66.6*	*49.7*	*54.1*
143	Sudan	1.1	1.1	74.4	72.9	1'703	7'634	14.0	*15.3*	29.3	*29.3*
144	Suriname	16.2	15.8	106.5	127.3	173'164	201'607	30.7 [9]	*33.8*	17.3 [10]	*19.0*
145	Swaziland	3.7 [26]	*3.7*	65.4	*71.5*	1'818	*3'240*	*11.9*	*12.5*	*11.4*	*13.4*
146	Sweden	43.8	*40.6*	124.6	*124.4*	*338'500*	*374'786*	92.3	91.9	91.7	92.6
147	Switzerland	59.0	57.9 [5]	132.1	133.8 [7]	*220'142*	*314'129*	*85.8*	*86.6*	*90.0*	*91.8*
148	Syria	19.4	20.2	59.3	56.0	3'760	3'312	*43.0*	*45.3*	*38.0*	*39.4*
149	Tanzania	0.4	0.3	57.0	55.7	*3'974*	*6'460*	*3.2*	*3.4*	*3.3*	*3.7*
150	TFYR Macedonia	19.4 [27]	19.0 [25]	106.2	106.2 [26]	*33'894*	*36'446*	64.2	*68.3*	58.3	*61.9*
151	Thailand	9.5	9.0	127.3	138.0	26'690	37'370	26.9 [10]	28.7	17.6 [11]	22.7 [8]
152	Trinidad & Tobago	21.4	21.7	140.8	144.9	18'442 [7]	17'156	*61.0*	*65.0*	*40.0*	*45.0*
153	Tunisia	10.1	9.3	118.1	115.6	18'745	19'134	23.2	*25.4*	17.1	*18.2*
154	Turkey	18.7	18.1	91.5	93.0	40'629	65'516	50.2	52.9	47.2	49.1
155	Uganda	0.9	0.6 [20]	45.0 [6]	*44.1* [19]	4'670	*4'218*	*4.0*	*4.9*	*4.2*	*5.2*
156	Ukraine	26.8	26.2	130.3	138.1	*49'818*	*52'883*	40.5	*40.5*	35.6	*43.7*
157	United Arab Emirates	21.4	22.3	149.6	171.9	32'445	52'325	85.2	*90.2*	72.0	*76.1*
158	United Kingdom	52.9	52.9	124.8	123.8	*291'319*	*352'583*	87.2	88.2	86.8	88.4
159	United States	43.5	42.2 [5]	96.0	95.5 [7]	63'285	*64'089*	78.9 [11]	*80.0*	74.8 [12]	*77.3*
160	Uruguay	29.8	30.8	147.1 [28]	154.6 [27]	41'128 [17]	59'935 [15]	63.7	*67.6*	48.4	*52.7*
161	Uzbekistan	6.9	*6.9*	71.0 [29]	*74.3*	959	*1'809*	*8.0*	*9.3*	*9.6*	*9.5*
162	Venezuela	25.5	25.6 [13]	102.1	101.6 [1]	*9'801*	*10'184*	37.8	*41.0*	28.6	*31.5*
163	Viet Nam	*11.2*	*10.1*	*147.7*	130.9	*9'763*	*15'903*	*17.5*	*19.0*	*15.6*	*17.1*
164	Yemen	4.6	*4.7*	58.3	*69.0*	2'788	*2'458*	*5.0*	*5.6*	*4.7*	*4.7*
165	Zambia	0.6	*0.8*	74.8	71.5 [28]	2'721	4'181	*5.2*	*5.9*	*4.7*	*5.9*
166	Zimbabwe	2.2	2.1	91.9	96.3	2'643	3'461	*6.5*	*7.0*	*4.9*	*5.3*

Note: Data in italics refer to ITU estimates. For further notes, see p. 248.
Source: ITU World Telecommunication/ICT Indicators database.

Use indicators

	Economy	Percentage of individuals using the Internet 2012	2013	Fixed (wired)-broadband subscriptions per 100 inhabitants 2012	2013	Wireless-broadband subscriptions per 100 inhabitants 2012	2013
1	Afghanistan	5.5	5.9	0.0	0.0	0.4	1.2
2	Albania	54.7	60.1	5.1	5.8	18.8	28.2
3	Algeria	15.2	16.5	3.0	3.3	0.0 [1]	0.0 [1]
4	Andorra	86.4	94	34.3	34.6 [1]	40.2	52.3
5	Angola	16.9	19.1	0.2	0.2	7.2	12.5
6	Antigua & Barbuda	59	63.4	4.6	4.5	23.2	48.9
7	Argentina	55.8	59.9	12.5	13.9 [2]	16.4	19.8 [2]
8	Armenia	39.2	46.3	7.0	7.9	29.1	31.3
9	Australia	79.0 [1]	83.0 [1]	24.3 [1]	25.0 [3]	96.2 [2]	111.1 [3]
10	Austria	80.0 [2]	80.6 [2]	25.0	26.0	56.3	64.5
11	Azerbaijan	54.2	58.7	13.8	17.0	29.5	45.1
12	Bahrain	88 [3]	90.0	13.2	13.1	91.2 [3]	119.0
13	Bangladesh	5.8	6.5 [3]	0.4	0.6	0.5	0.5
14	Barbados	73.3	75.0	23.6	23.8	36.0	41.5
15	Belarus	46.9 [4]	54.2 [4]	26.9 [2]	29.8	33.3	46.0
16	Belgium	80.7 [2]	82.2 [2]	33.3	34.4	33.0	46.0
17	Benin	4.5	4.9	0.0	0.0	0.4	0.4
18	Bhutan	25.4	29.9	2.3 [3]	2.7 [4]	2.5 [4]	15.6 [4]
19	Bolivia	35.5 [5]	39.5	1.1 [4]	1.3	6.6 [5]	14.0 [5]
20	Bosnia and Herzegovina	65.4	67.9	10.6	11.8	12.2 [6]	23.9 [6]
21	Botswana	11.5	15.0	0.9	1.1	74.9 [7]	74.3 [7]
22	Brazil	48.6 [6]	51.6	9.2	10.1 [5]	33.7	52.0 [8]
23	Brunei Darussalam	60.3	64.5	4.8	5.7	7.6	6.5
24	Bulgaria	51.9 [2]	53.1 [2]	17.9 [5]	19.0 [6]	48.5 [8]	58.6 [9]
25	Burkina Faso	3.7	4.4	0.1	0.1	0.0	9.0
26	Cambodia	4.9	6.0 [5]	0.2	0.2	6.7	10.1
27	Cameroon	5.7	6.4	0.1	0.1	0.0	1.7
28	Canada	83.0 [7]	85.8	32.5	33.3	42.1	57.9
29	Cape Verde	34.7	37.5	4.0	4.3	23.0	42.6
30	Central African Rep.	3.0	3.5	0.0	0.0	0.0	0.1
31	Chad	2.1	2.3	0.2	0.1	0.0	0.0
32	Chile	61.4 [8]	66.5	12.3	12.3	28.3	35.6
33	China	42.3	45.8 [6]	12.7	13.6	16.9	21.4
34	Colombia	49.0	51.7 [7]	8.2	9.3	14.8	25.1
35	Congo	6.1	6.6	0.0	0.0 [7]	2.1	10.5
36	Congo (Dem. Rep.)	1.7	2.2	0.0	0.0	5.9	6.7
37	Costa Rica	47.5 [9]	46.0 [8]	9.3	9.7 [7]	54.6 [9]	72.3 [10]
38	Côte d'Ivoire	2.4	2.6	0.2	0.3	1.0	1.7
39	Croatia	61.9 [2]	66.7 [2]	20.7	21.5	53.9	66.1
40	Cuba	25.6	25.7 [4]	0.0	0.0	0.0	0.0
41	Cyprus	60.7 [2]	65.5 [2]	19.2	19.9	34.1	31.8
42	Czech Republic	73.4 [2]	74.1 [2]	16.4	17.0 [7]	52.1 [10]	54.4 [11]
43	Denmark	92.3 [2]	94.6 [2]	38.8	40.2	97.4	107.5
44	Djibouti	8.3	9.5	1.7	2.0	0.0	0.0
45	Dominica	55.2	59.0	11.9	14.8	0.0	0.0
46	Dominican Rep.	41.2 [10]	45.9 [9]	4.3	4.7	15.6	25.8
47	Ecuador	35.1 [11]	40.4 [10]	5.3	6.3	21.6	26.7
48	Egypt	44.0 [12]	49.6 [4]	2.8	3.3	27.9	31.1
49	El Salvador	20.3	23.1 [11]	3.8	4.5	5.5	7.5
50	Eritrea	0.8	0.9	0.0	0.0	0.0	0.0
51	Estonia	78.4	80.0 [2]	25.5	26.5	76.9	78.9
52	Ethiopia	1.5	1.9	0.0	0.3	4.4	4.9
53	Fiji	33.7	37.1	1.5	1.2	23.4	53.5
54	Finland	89.9 [2]	91.5 [2]	30.4 [6]	30.9	106.6	123.6
55	France	81.4 [2]	81.9 [2]	37.5	38.8	51.8	55.9
56	Gabon	8.6	9.2	0.3	0.5	0.0	0.5
57	Gambia	12.4	14.0	0.0	0.0	1.4	1.4
58	Georgia	36.9	43.1 [4]	9.0	10.2	8.9 [11]	17.4
59	Germany	82.3 [2]	84.0 [2]	33.7	34.6 [8]	40.6 [12]	44.8 [12]
60	Ghana	12.3 [13]	12.3 [12]	0.3	0.3	33.9	40.2
61	Greece	55.1 [2]	59.9 [2]	24.1	26.2	34.4	36.1
62	Grenada	32.0	35.0	15.2	17.0	0.0	0.8
63	Guatemala	16.0	19.7	1.8 [7]	1.8 [9]	4.5 [13]	6.2
64	Guinea	1.5	1.6	0.0	0.0	0.0	0.0 [13]
65	Guinea-Bissau	2.9	3.1	0.0	0.0	0.0	0.0
66	Guyana	33.0	33.0	3.7	4.6	0.1	0.1
67	Honduras	18.1	17.8	0.8 [8]	0.8 [10]	8.6 [14]	11.7 [14]
68	Hong Kong, China	72.9 [14]	74.2 [13]	31.2	30.8	83.2	95.4
69	Hungary	70.6 [2]	72.6 [2]	22.9	24.1	24.2	27.5
70	Iceland	96.2 [2]	96.5 [2]	34.3	35.1	70.9	74.7
71	India	12.6	15.1	1.2 [9]	1.2 [11]	2.4	3.2 [15]
72	Indonesia	14.7	15.8	1.2	1.3	31.6	36.0
73	Iran (I.R.)	27.5	31.4	4.0	5.6	1.3 [15]	2.5 [16]
74	Ireland	76.9 [2]	78.2 [2]	22.7	24.2	65.9	68.6
75	Israel	70.8 [15]	70.8 [14]	25.3	25.7	53.0	52.5 [17]
76	Italy	55.8 [2]	58.5 [2]	22.1	22.3	53.5 [16]	65.9 [18]
77	Jamaica	33.8 [16]	37.8	4.4	4.8	22.6	33.1
78	Japan	86.3 [17]	86.3 [2]	28.4 [9]	28.8 [12]	112.4	120.5
79	Jordan	41.0	44.2	2.8	2.8	11.3	17.8
80	Kazakhstan	53.3	54.0	9.8	11.6	42.5	56.6
81	Kenya	32.1	39.0	0.1	0.1	2.2	3.1
82	Korea (Rep.)	84.1	84.8 [15]	37.2	38.0	105.1	105.3
83	Kyrgyzstan	21.7	23.4	0.9	1.0	19.1 [17]	22.7

	Economy	Percentage of individuals using the Internet		Fixed (wired)-broadband subscriptions per 100 inhabitants		Wireless-broadband subscriptions per 100 inhabitants	
		2012	2013	2012	2013	2012	2013
84	Lao P.D.R.	*10.7*	*12.5*	*0.1* [10]	*0.1*	2.1 [18]	*2.4*
85	Latvia	73.1 [2]	75.2 [2]	*23.3*	*24.7*	*58.2*	*61.2*
86	Lebanon	*61.2*	*70.5*	9.7	10.0	28.3	43.0
87	Lesotho	*4.6*	*5.0*	0.1	0.1	*7.5*	11.5
88	Liberia	*3.8*	*4.6*	0.0	0.0	0.0	1.9
89	Lithuania	67.2 [2]	68.5 [2]	21.1	22.0	41.4	53.8
90	Luxembourg	91.9 [2]	93.8 [2]	32.4	33.5	*80.6* [19]	80.5 [19]
91	Macao, China	61.3 [18]	65.8 [15]	26.0	26.8	288.7	303.4
92	Madagascar	*2.1*	*2.2*	0.0	0.1	0.4	0.5
93	Malawi	*4.4*	*5.4*	0.0	0.0	3.5	3.9
94	Malaysia	65.8 [19]	67.0 [16]	8.4	8.2	13.4	14.1
95	Maldives	*38.9*	*44.1*	5.3	5.8	25.3	26.2
96	Mali	*2.2*	*2.3*	0.0	0.0	*0.7*	1.8
97	Malta	68.2 [2]	68.9 [2]	31.1	32.8	35.0	41.2
98	Mauritania	*5.4*	*6.2*	0.2	0.2 [13]	3.6 [20]	5.6
99	Mauritius	35.4 [20]	39.0	11.2	12.5	22.9	29.2
100	Mexico	39.8 [21]	43.5 [4]	10.5 [11]	*11.1*	7.7 [21]	*11.5*
101	Moldova	*43.4*	*48.8*	11.9	13.4	43.8	47.3
102	Monaco	*87.0*	*90.7*	43.3 [12]	44.7	47.9	*53.7*
103	Mongolia	16.4 [22]	*17.7*	3.7	4.9	18.4	24.7
104	Montenegro	56.8	*56.8*	*11.2*	*12.8*	*16.8*	*23.1*
105	Morocco	55.4	56.0	2.1	2.5	10.1	15.0
106	Mozambique	*4.8*	*5.4*	0.1	0.1	*1.8*	*1.7*
107	Myanmar	*1.1*	*1.2*	0.1	0.2	0.0	1.0
108	Namibia	*12.9*	*13.9*	1.2	1.3	33.2	34.2
109	Nepal	*11.1*	*13.3*	*0.6*	*0.8*	*10.9*	*13.0*
110	Netherlands	92.9 [2]	94.0 [2]	39.8	40.1 [14]	61.3	62.3 [20]
111	New Zealand	82.0 [1]	*82.8*	27.8	29.2	65.9	81.9
112	Nicaragua	*13.5*	*15.5*	1.7	2.2 [7]	*1.0*	1.3 [10]
113	Niger	*1.4*	*1.7*	0.0	*0.0*	0.6	*0.9*
114	Nigeria	32.8	38.0	0.0	0.0	6.7	10.1
115	Norway	94.6 [2]	95.1 [2]	36.3	36.4 [15]	84.8	86.5 [21]
116	Oman	*60.0*	66.5 [17]	2.1	2.6	50.9	68.9
117	Pakistan	*10.0*	*10.9*	0.5	0.6	0.7	0.8
118	Palestine	43.4	*46.6*	4.4	4.7	0.8	0.9
119	Panama	40.3 [23]	*42.9*	7.8 [11]	7.7 [7]	25.3 [22]	*25.2* [22]
120	Paraguay	29.3 [6]	36.9 [18]	1.2	1.6	6.0	5.6
121	Peru	38.2 [21]	39.2 [4]	4.7	5.2	2.6	3.0
122	Philippines	*36.2*	*37.0*	*2.2*	*2.6*	24.0	27.2
123	Poland	62.3 [2]	62.8 [2]	15.6 [13]	*15.6*	63.6	*59.5*
124	Portugal	60.3 [2]	62.1 [2]	22.5	23.8	32.8	36.7
125	Qatar	69.3 [19]	85.3 [16]	9.0 [14]	9.9 [16]	61.8 [23]	76.8 [23]
126	Romania	45.9 [2]	49.8 [2]	16.1 [15]	17.3 [17]	27.0	37.7
127	Russian Federation	63.8	61.4 [19]	14.5	16.6	52.8	60.2
128	Rwanda	*8.0*	*8.7*	0.0	0.0	3.2	*5.8*
129	Saudi Arabia	*54.0*	*60.5*	6.9	7.3	58.4	70.6
130	Senegal	*19.2*	*20.9*	0.7	0.8	3.6	15.3
131	Serbia	*48.1*	*51.5*	12.9	13.9	52.0	55.7
132	Seychelles	*47.1*	*50.4*	11.0	12.9	8.6	10.3
133	Singapore	72.0 [24]	73.0 [20]	25.4	25.7 [11]	126.1	136.6 [24]
134	Slovakia	76.7 [2]	77.9 [2]	14.7	15.5	39.7	54.9
135	Slovenia	68.3 [2]	72.7 [2]	24.3	25.0	36.7	42.1
136	Solomon Islands	*7.0*	*8.0*	0.4	0.3	6.5	8.0
137	South Africa	*41.0*	*48.9*	*2.1*	3.1	*25.2*	28.7
138	Spain	69.8 [2]	71.6 [2]	24.4	25.6 [18]	53.6	67.2 [25]
139	Sri Lanka	18.3	*21.9*	*1.7*	2.0	7.8	7.8
140	St. Kitts and Nevis	*79.3*	*80.0*	24.3	24.5 [19]	*0.0*	*5.5*
141	St. Lucia	34.8 [1]	*35.2*	13.6	13.7	19.1 [17]	32.7
142	St. Vincent and the Grenadines	47.5	*52.0*	12.4	13.4	0.0	0.0 [26]
143	Sudan	21.0 [1]	*22.7*	0.1	0.1	20.5	26.8
144	Suriname	*34.7*	*37.4*	5.5	6.9	15.0 [24]	13.1
145	Swaziland	*20.8*	*24.7*	0.3	*0.3*	*3.2*	*4.4*
146	Sweden	93.2 [2]	94.8 [2]	32.3	*32.6*	104.9	*110.3*
147	Switzerland	85.2 [25]	86.7 [21]	40.1	43.0	39.6	44.3 [27]
148	Syria	*24.3*	*26.2*	1.1	1.6	1.7	3.2
149	Tanzania	*4.0*	*4.4*	0.1	0.1	2.3	2.7
150	TFYR Macedonia	57.4 [2]	*61.2*	13.7 [16]	15.7 [14]	25.1	39.4 [21]
151	Thailand	26.5 [21]	28.9 [4]	6.5	7.4	11.0	52.5
152	Trinidad & Tobago	*59.5*	*63.8*	13.8	14.6	8.4	20.2
153	Tunisia	*41.4*	*43.8*	4.9	4.8	15.9	26.1
154	Turkey	45.1 [26]	46.3 [2]	10.6	11.2	26.7	32.3
155	Uganda	*14.7*	*16.2*	0.1 [9]	*0.1*	*7.4* [25]	*8.6*
156	Ukraine	35.3	*41.8*	8.0	8.8	*5.4*	*6.7*
157	United Arab Emirates	85.0 [27]	*88.0*	10.3 [17]	11.1 [20]	44.8 [26]	89.1 [28]
158	United Kingdom	87.5 [2]	89.8 [2]	34.4 [18]	35.7 [21]	77.0 [27]	87.2
159	United States	79.3 [28]	*84.2*	28.5 [19]	28.5 [22]	89.7	93.6 [17]
160	Uruguay	54.5 [21]	*58.1*	16.6 [20]	21.1	32.5 [28]	*43.5*
161	Uzbekistan	*36.5*	*38.2*	0.7	*1.1*	20.4	*22.8*
162	Venezuela	49.1	*54.9*	6.7	7.3 [2]	4.8	3.8 [2]
163	Viet Nam	*39.5*	*43.9*	*4.9*	*5.6*	*18.8*	*21.8*
164	Yemen	*17.4*	*20.0*	0.7	*1.1*	0.2	*0.3*
165	Zambia	*13.5*	*15.4*	0.1	0.1	0.6	*0.7*
166	Zimbabwe	*17.1*	*18.5*	0.5	0.7	28.1	37.8

Note: Data in italics refer to ITU estimates. For further notes, see p. 248.
Source: ITU World Telecommunication/ICT Indicators database.

Skills indicators

		Gross enrolment ratio				Adult literacy rate	
		Seconday		Tertiary			
	Economy	2012	2013	2012	2013	2012	2013
1	Afghanistan	54.0	54.0	3.7	3.7	31.7	31.7
2	Albania	82.4	82.4	55.5	55.5	96.8	96.8
3	Algeria	97.6	97.6	31.5	31.5	72.6	72.7
4	Andorra	130.8	130.8	84.6	84.6	97.9	97.9
5	Angola	31.5	31.5	7.5	7.5	70.6	70.6
6	Antigua & Barbuda	105.4	105.4	23.5	23.5	99.0	99.0
7	Argentina	91.9	91.9	78.6	78.6	97.9	97.9
8	Armenia	95.9	95.9	46.0	46.0	99.6	99.6
9	Australia	135.5	135.5	86.3	86.3	99.0	99.0
10	Austria	97.7	97.7	72.4	72.4	99.0	99.0
11	Azerbaijan	100.3	100.3	20.4	20.4	99.8	99.8
12	Bahrain	95.5	95.5	33.5	33.5	94.6	94.6
13	Bangladesh	53.6	53.6	13.2	13.2	58.8	58.8
14	Barbados	104.7	104.7	60.8	60.8	99.0	99.0
15	Belarus	106.4	106.4	91.5	91.5	99.6	99.6
16	Belgium	107.3	107.3	70.8	70.8	99.0	99.0
17	Benin	47.7	47.7	12.4	12.4	28.7	28.7
18	Bhutan	73.9	73.9	9.5	9.5	52.8	52.8
19	Bolivia	77.3	77.3	37.7	37.7	94.5	94.5
20	Bosnia and Herzegovina	89.3	89.3	37.7	37.7	98.2	98.2
21	Botswana	81.7	81.7	7.4	7.4	86.7	86.7
22	Brazil	105.8	105.8	25.6	25.6	91.3	91.3
23	Brunei Darussalam	107.8	107.8	24.3	24.3	95.4	95.4
24	Bulgaria	93.1	93.1	62.7	62.7	98.4	98.4
25	Burkina Faso	25.9	25.9	4.6	4.6	28.7	28.7
26	Cambodia	45.0	45.0	15.8	15.8	73.9	73.9
27	Cameroon	50.4	50.4	11.9	11.9	71.3	71.3
28	Canada	103.4	103.4	66.6	66.6	99.0	99.0
29	Cape Verde	92.7	92.7	20.6	20.6	85.3	85.3
30	Central African Rep.	17.8	17.8	2.8	2.8	36.8	36.8
31	Chad	22.8	22.8	2.3	2.3	37.3	37.3
32	Chile	89.0	89.0	74.4	74.4	98.6	98.6
33	China	89.0	89.0	26.7	26.7	95.1	95.1
34	Colombia	92.8	92.8	45.0	45.0	93.6	93.6
35	Congo	53.7	53.7	10.4	10.4	79.3	79.3
36	Congo (Dem. Rep.)	43.3	43.3	8.2	8.2	61.2	61.2
37	Costa Rica	103.6	103.6	46.7	46.7	97.4	97.4
38	Côte d'Ivoire	24.3	24.3	4.5	4.5	41.0	41.0
39	Croatia	98.4	98.4	61.6	61.6	99.1	99.1
40	Cuba	90.2	90.2	62.5	62.5	99.8	99.8
41	Cyprus	95.3	95.3	45.9	45.9	98.7	98.7
42	Czech Republic	96.6	96.6	64.2	64.2	99.0	99.0
43	Denmark	124.7	124.7	79.6	79.6	99.0	99.0
44	Djibouti	43.8	46.2	4.9	4.9	94.2	94.2
45	Dominica	96.7	96.7	3.6	3.6	89.1	89.1
46	Dominican Rep.	75.9	75.9	34.2	34.2	90.2	90.9
47	Ecuador	86.8	86.8	38.9	38.9	91.6	93.3
48	Egypt	86.3	86.3	30.1	30.1	73.9	73.9
49	El Salvador	69.2	69.2	25.5	25.5	85.5	85.5
50	Eritrea	29.8	29.8	2.0	2.0	70.5	70.5
51	Estonia	107.1	107.1	76.7	76.7	99.9	99.9
52	Ethiopia	28.9	28.9	2.8	2.8	39.0	39.0
53	Fiji	88.3	88.3	16.1	16.1	95.1	95.1
54	Finland	107.7	107.7	93.7	93.7	99.0	99.0
55	France	109.7	109.7	58.3	58.3	99.0	99.0
56	Gabon	53.9	53.9	8.5	8.5	82.3	82.3
57	Gambia	57.5	57.5	3.4	3.4	52.0	52.0
58	Georgia	86.8	86.8	27.9	27.9	99.7	99.7
59	Germany	101.3	101.3	61.7	61.7	99.0	99.0
60	Ghana	58.2	61.1	12.2	12.2	71.5	71.5
61	Greece	107.9	107.9	114.0	114.0	97.4	97.4
62	Grenada	107.8	107.8	52.8	52.8	99.0	99.0
63	Guatemala	65.1	65.1	17.9	17.9	78.3	78.3
64	Guinea	38.1	38.1	9.9	9.9	25.3	25.3
65	Guinea-Bissau	34.5	34.5	2.6	2.6	56.7	56.7
66	Guyana	101.0	101.0	12.9	12.9	85.0	85.0
67	Honduras	73.1	73.1	20.4	20.4	85.4	85.4
68	Hong Kong, China	88.7	88.7	59.7	59.7	99.0	99.0
69	Hungary	101.6	101.6	59.6	59.6	99.4	99.4
70	Iceland	108.6	108.6	80.9	80.9	99.0	99.0
71	India	68.5	68.5	24.8	24.8	62.8	62.8
72	Indonesia	82.5	82.5	31.5	31.5	92.8	92.8
73	Iran (I.R.)	86.3	86.3	55.2	55.2	84.3	84.3
74	Ireland	119.1	119.1	71.2	71.2	96.7	96.7
75	Israel	101.7	101.7	65.8	65.8	97.8	97.8
76	Italy	100.7	100.7	62.5	62.5	99.0	99.0
77	Jamaica	88.6	88.6	30.8	30.8	87.5	87.5
78	Japan	101.8	101.8	61.5	61.5	99.0	99.0
79	Jordan	87.8	87.8	46.6	46.6	97.9	97.9
80	Kazakhstan	97.7	97.7	44.5	44.5	99.7	99.7
81	Kenya	60.1	60.1	4.0	4.0	72.2	72.2
82	Korea (Rep.)	97.2	97.2	98.4	98.4	99.0	99.0
83	Kyrgyzstan	88.2	88.2	41.3	41.3	99.2	99.2

		Gross enrolment ratio				Adult literacy rate	
		Seconday		Tertiary			
	Economy	2012	2013	2012	2013	2012	2013
84	Lao P.D.R.	46.5	*46.5*	16.7	*16.7*	*72.7*	*72.7*
85	Latvia	97.7	*97.7*	65.1	*65.1*	*99.9*	*99.9*
86	Lebanon	74.0	*74.0*	46.3	*46.3*	*89.6*	*89.6*
87	Lesotho	53.3	*53.3*	10.8	*10.8*	*75.8*	*75.8*
88	Liberia	*45.2*	*45.2*	11.6	*11.6*	*42.9*	*42.9*
89	Lithuania	105.9	*105.9*	73.9	*73.9*	*99.8*	*99.8*
90	Luxembourg	*101.0*	*101.0*	*18.2*	*18.2*	*94.4*	94.4
91	Macao, China	96.5	*96.5*	*64.0*	*64.0*	*95.6*	95.6
92	Madagascar	38.0	*38.0*	4.2	*4.2*	*64.5*	*64.5*
93	Malawi	34.2	*34.2*	*0.8*	0.8	*61.3*	*61.3*
94	Malaysia	*67.2*	*67.2*	*36.0*	*36.0*	*93.1*	*93.1*
95	Maldives	*72.3*	*72.3*	*13.2*	*13.2*	*98.4*	*98.4*
96	Mali	*44.5*	*44.5*	7.5	*7.5*	*33.6*	*33.6*
97	Malta	86.3	*86.3*	41.2	*41.2*	*92.4*	*92.4*
98	Mauritania	26.8	*26.8*	5.1	*5.1*	*45.5*	*45.5*
99	Mauritius	95.9	*95.9*	40.3	*40.3*	*89.2*	*89.2*
100	Mexico	85.7	*85.7*	29.0	*29.0*	94.2	*94.2*
101	Moldova	88.2	*88.2*	40.1	*40.1*	99.1	*99.1*
102	Monaco	*109.7*	*109.7*	*54.9*	*54.9*	*99.0*	*99.0*
103	Mongolia	103.5	*103.5*	61.1	*61.1*	*98.3*	*98.3*
104	Montenegro	90.9	*90.9*	*55.5*	*55.5*	*98.4*	*98.4*
105	Morocco	68.9	*68.9*	*16.2*	*16.2*	*67.1*	*67.1*
106	Mozambique	25.9	*25.9*	*4.9*	*4.9*	*50.6*	*50.6*
107	Myanmar	*50.2*	*50.2*	*13.8*	*13.8*	92.6	*92.6*
108	Namibia	*64.8*	*64.8*	*9.3*	*9.3*	*76.5*	*76.5*
109	Nepal	65.8	66.6	*14.5*	*14.5*	*57.4*	*57.4*
110	Netherlands	129.9	*129.9*	77.3	*77.3*	*99.0*	*99.0*
111	New Zealand	119.5	*119.5*	79.8	*79.8*	*99.0*	*99.0*
112	Nicaragua	*68.9*	*68.9*	*17.9*	*17.9*	*78.0*	*78.0*
113	Niger	15.9	*15.9*	1.8	*1.8*	15.5	*15.5*
114	Nigeria	*43.8*	*43.8*	*10.4*	*10.4*	*51.1*	*51.1*
115	Norway	111.1	*111.1*	74.1	*74.1*	*99.0*	*99.0*
116	Oman	93.5	*93.5*	*28.1*	*28.1*	*86.9*	*86.9*
117	Pakistan	36.6	*36.6*	9.5	*9.5*	*54.7*	*54.7*
118	Palestine	82.8	*82.8*	49.1	*49.1*	95.9	*95.9*
119	Panama	84.0	*84.0*	*41.8*	*41.8*	*94.1*	*94.1*
120	Paraguay	*69.6*	*69.6*	*34.5*	*34.5*	*93.9*	*93.9*
121	Peru	89.8	*89.8*	*42.6*	*42.6*	93.8	*93.8*
122	Philippines	*84.6*	*84.6*	*28.2*	*28.2*	*95.4*	*95.4*
123	Poland	97.7	*97.7*	73.2	*73.2*	99.8	*99.8*
124	Portugal	112.9	*112.9*	68.9	*68.9*	*94.5*	*94.5*
125	Qatar	*111.6*	*111.6*	12.1	*12.1*	96.7	*96.7*
126	Romania	95.0	*95.0*	*51.6*	*51.6*	*98.6*	*98.6*
127	Russian Federation	95.3	*95.3*	76.1	*76.1*	*99.7*	*99.7*
128	Rwanda	31.8	*31.8*	7.2	*7.2*	*65.9*	*65.9*
129	Saudi Arabia	114.3	116.2	50.9	*50.9*	94.4	94.4
130	Senegal	*41.0*	*41.0*	*7.6*	*7.6*	*52.1*	*52.1*
131	Serbia	91.7	*91.7*	52.4	*52.4*	98.2	*98.2*
132	Seychelles	*101.3*	*101.3*	1.4	*1.4*	*91.8*	*91.8*
133	Singapore	97.2	*97.2*	*43.8*	*43.8*	96.4	*96.4*
134	Slovakia	93.9	*93.9*	55.1	*55.1*	99.5	*99.5*
135	Slovenia	97.6	*97.6*	86.0	*86.0*	*99.7*	*99.7*
136	Solomon Islands	48.4	*48.4*	*16.1*	*16.2*	98.7	*98.7*
137	South Africa	101.9	*101.9*	*15.8*	*15.8*	93.7	*93.7*
138	Spain	130.8	*130.8*	84.6	*84.6*	97.9	*97.9*
139	Sri Lanka	99.3	*99.3*	17.0	*17.0*	91.2	*91.2*
140	St. Kitts and Nevis	94.5	*94.5*	*18.2*	*18.2*	*98.4*	*98.4*
141	St. Lucia	91.1	*91.1*	10.2	*10.2*	*99.0*	*99.0*
142	St. Vincent and the Grenadines	100.9	*100.9*	*18.2*	*18.2*	*99.0*	*99.0*
143	Sudan	*37.0*	*37.0*	15.1	*15.1*	73.4	*73.4*
144	Suriname	*85.4*	*85.4*	*12.1*	*12.1*	*94.7*	*94.7*
145	Swaziland	*59.9*	*59.9*	*6.0*	*6.0*	*83.1*	*83.1*
146	Sweden	98.4	*98.4*	70.0	*70.0*	*99.0*	*99.0*
147	Switzerland	96.3	*96.3*	55.6	*55.6*	98.7	*98.7*
148	Syria	74.4	*74.4*	*25.6*	*25.6*	85.1	*85.1*
149	Tanzania	35.0	*35.0*	3.9	*3.9*	*67.8*	*67.8*
150	TFYR Macedonia	82.8	*82.8*	38.5	*38.5*	97.5	*97.5*
151	Thailand	*87.0*	*87.0*	51.4	51.2	96.4	*96.4*
152	Trinidad & Tobago	*85.5*	*85.5*	*12.0*	*12.0*	98.8	*98.8*
153	Tunisia	*91.1*	*91.1*	35.2	*35.2*	*79.7*	*79.7*
154	Turkey	86.1	*86.1*	69.4	*69.4*	94.9	*94.9*
155	Uganda	27.6	*27.6*	*9.1*	*9.1*	*73.2*	*73.2*
156	Ukraine	97.8	*97.8*	79.7	*79.7*	99.7	*99.7*
157	United Arab Emirates	*83.6*	*83.6*	*30.4*	*30.4*	90.0	*90.0*
158	United Kingdom	95.4	*95.4*	61.9	*61.9*	95.2	*95.2*
159	United States	93.7	*93.7*	94.3	*94.3*	99.0	*99.0*
160	Uruguay	*90.3*	*90.3*	*63.2*	*63.2*	98.4	*98.4*
161	Uzbekistan	*105.2*	*105.2*	*8.9*	*8.9*	99.5	*99.5*
162	Venezuela	85.4	*85.4*	*78.1*	*78.1*	*95.5*	*95.5*
163	Viet Nam	*77.2*	*77.2*	24.6	*24.6*	*93.5*	*93.5*
164	Yemen	46.9	*46.9*	*10.3*	*10.3*	66.4	*66.4*
165	Zambia	*45.5*	*45.5*	2.4	*2.4*	*61.4*	*61.4*
166	Zimbabwe	*41.4*	*41.4*	5.9	*5.9*	*83.6*	*83.6*

Note: Data in italics refer to ITU estimates.
Source: ITU World Telecommunication/ICT Indicators database.

Notes

Access indicators

Fixed-telephone subscriptions per 100 inhabitants, 2012:

1) Incl. 524 958 WLL subscriptions. 2) Incl. payphone, excl. VOIP. 3) Incl. ISDN channels measured in ISDNB channels equivalents. 4) Incl. VoIP. 5) Bhutan Telecom is the only service provider as of now in Bhutan. 6) By December. 7) Fixed and WLL. 8) Total access lines. 9) First trimester 2012. 5 431 registered subscriptions. 10) Estimate. 11) Incl. public payphones. 12) Decrease is caused by change in tariff policy of the biggest WLL operator. 13) Data excluding own (NRA) consumption. 14) Excl. voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents. 15) Incl. PSTN lines, ISDN paths, FWA subscriptions, public payphones and VOIP subscriptions. 16) Incl. Telecom Italia access lines, ULL, Virtual ULL, Naked DSL, Wholesale line Rental, Fiber, Public Telephony. 17) The number of fixed public payphones is as of March 2012. 18) Fixed Wireless Local Loop. 19) Including digital lines. Without ISDN channels. 20) Excl. ISDN channels and fixed wireless subscriptions. 21) Incl. inactive subscriptions. 22) Preliminary.23) Refers to active Fixed Wired/Wireless lines. 24) POTS, ISDN BRA & ISDN PRA. 25) Decrease due to cleaning out of inactive accounts. 26) Excluding fixed wireless. 27) Excl. internal lines and WLR of incumbent.

Fixed-telephone subscriptions per 100 inhabitants, 2013

1) Incl. 420 000 WLL subscriptions. 2) Incl. payphone, excl. VOIP. 3) Incl. ISDN channels measured in ISDNB channels equivalents. 4) Incl. VoIP. 5) Estimate. 6) Bhutan Telecom is the only service provider as of now in Bhutan. 7) By December 2013. 8) Excl. voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents. 9) Incl. PSTN lines, ISDN paths, FWA subscriptions, public payphones and VOIP subscriptions. 10) Total number of access paths. 11) Incl. Telecom Italia access lines, ULL, Virtual ULL, Naked DSL, Wholesale line Rental, Fiber, Public Telephony. 12) The number of fixed public payphones is as of March 2013. 13) Preliminary. 14) Incl. digital lines. Without including separate ISDN channels (abonnements au téléphone fixe). 15) Excl. ISDN channels and fixed wireless subscriptions. 16) Break in comparability. Only active subscriptions. Inactive subscriptions are: 45 609. 17) February 2013 NTA MIS. 18) Based on 2013Q3 data. 19) Refers to active Fixed Wired/Wireless lines. 20) Per June 2013. 21) Operators' data. 22) Residential: 3.3 million; business: 1.4 million. 23) Q4 report. Definitive data (annual report) may change because quarterly reports use a smaller sample of operators than annual report. 24) Fixed and fixed-wireless subscriptions. 25) Excl. internal lines and WLR of incumbent. Data for the third quarter of 2013.

Mobile-cellular subscriptions per 100 inhabitants, 2012:

1) Numbers are down due to data cleanse. 2)ACMA Communications Report 2011-12. 2) incl. payphone, excl. VoIP. 3) Active subscriptions. 4) Bhutan Telecom and Tashi Cell are the only two service providers in Bhutan. 5) Activity criteria: voice or data communication in the last month. 6) December 2012. 7) Total number of subscriptions (including non-active): 2 082 589. 8) Excl. 2 720 698 prepaid cards that are used to provide Travel SIM/World Mobile service. 9) Excl. data-only SIM cards and M2M cards. 10) Decrease due to merge of second and third operators of the mobile market. 11) Incl. fixed wireless local loop (WLL) subscriptions. Drop is partly due to operators no longer including inactive subscriptions. 12) Incl. MNO and MVNO. 13) Decrease due to cancellation of subscriptions, since two operators merged. 14) December. Including PHS and data cards, undividable. 15) Decrease was due to registration of SIMs. 16) Figure obtained from all five mobile (GSM & CDMA) operators currently providing service in the country. 17) Incl. inactive subscriptions. 18) Preliminary. 19) Active subscriptions (87.85% total). 20) Measured using subscriptions active in the last 90 days. 21) Estimate. Incl. inactive. 22) Incl. data-only subscriptions (not possible to disaggregate the information at this point). 23) Break in comparability: excl. 226 827 M2M subscriptions. 24) Incl. active (in the last 6 months) prepaid accounts. 25) Registered SIM cards (incl. inactive): 261 887 751. 26) Break in comparability: from this year only counting prepaid subscriptions used in the last 90 days. 27) No differentiation between active and non-active subscriptions. 28) Incl. data dedicated subscriptions. 29) Decrease due to the closing of MTS.

Mobile-cellular subscriptions per 100 inhabitants, 2013:

1) Preliminary. 2) Active subscriptions. 3) Bhutan Telecom and Tashi Cell are the two service providers in Bhutan. 4) Activity criteria: voice or data communication in the last month. 5) By December 2013. 6) Incl. all mobile cellular subscriptions that offer voice communications, but excl. mobile data subscriptions (via data cards, USB modems and M2M cards). 7) Estimate. 8) Incl. data-only subscriptions. 9) Data based on NRA estimates. Excl. data-only SIM cards and M2M cards. 10) Incl. fixed wireless local loop (WLL) subscriptions. 11) Incl. PHS and data cards, undividable. 12) Active subscriptions (after clearing simcards that became inactive). 13) Figure obtained from all four mobile (GSM & CDMA) operators currently providing service in the country. 14) Break in comparability. Incl. only active subscriptions. 15) Active subscriptions (83.44% total). 16) February 2013 NTA MIS. 17) Based on 2013Q3 data. 18) Measured using subscriptions active in the last 90 days. 19) Per June 2013. 20) Excl. 463 646 M2M subscriptions. 21) Incl. active (in the last 6 months) prepaid accounts. 22) Registered SIM cards (incl. inactive): 277 744 809. 23) Pre-paid: 43.9 million; post-paid: 6.94 million. 24) No differentiation between active and non-active subscriptions. 25) Q4 report. Definitive data (annual report) may change because quarterly reports use a smaller sample of operators than annual report. 26) Data for the fourth quarter of 2013. 27) Incl. data dedicated subscriptions. 28) Reduction is due to implementation of sim cards registration.

International Internet bandwidth Bit/s per Internet user, 2012:

1) Refers to a survey conducted with the following companies: Global crossing, TIWS, Embratel e Globenet. 2) This is from one ISP only. No response received from other ISPs. 3) Symmetric. 4) Total installed capacity. 5) Purchased capacity. 6) By December 2012. 7) Estimate. 8) Activated external capacity. 9) Only ETL, LTC and LANIC. 10) Source: MOT. 11) Data obtained from nine service operators. 12) May 2012 purchased capacity. Lit capacity: 43 096 471 Mbit/s. 13) Incoming capacity; peak

weekly incoming capacity, averaged over 4 weeks in December. 14) Preliminary. 15) SLT Data. 16) Refers to the total capacity of the international bandwidth. 17) Potential (installed) capacity.

International Internet bandwidth Bit/s per Internet user, 2013:
1) Purchased capacity. 2) As at December 2013. 3) Total installed capacity. 4) May be revised with comprehensive data from mobile broadbnad providers. 5) Estimate. 6) June. 7) Sum of incoming capacity of all ISPs in the country. 8) Activated external capacity. 9) By September 2013. 10) Data obtained from eight service operators. 11) 1st April 2013 purchased capacity. Lit capacity: 70 464 304 Mbit/s. 12) Incoming capacity, average peak incoming capacity for December. 13) Not update for 2013. 14) Refers to the total capacity of the international bandwidth. 15) Potential (installed) capacity.

Percentage of households with computer, 2012:
1) Estimated based on 2011 proportion of households with a computer and using annual growth rate of 3%. 2) Preliminary. 3) Refers to PC or laptop. 4) Data correspond to dwellings (not households). 5) Ghana Living Standards Survey 2012/2013. The estimate is based on households who own and/or have access to a desktop, laptop or tablet PCs. Sample weights have been applied. 6) Personal computer included desktop computer, laptop / notebook / netbook / tablet and palm top / Personal Digital Assistant (PDA), but excluded digital diary and electronic dictionary. 7) Estimate. 8) From Household Socio-Economic survey-2012. 9) Census data. 10) Computer includes the number of personal computer, Notebook, and PDA. 11) U.S. Census Bureau, table 4 :http://www.census.gov/hhes/computer/publications/2012.html.

Percentage of households with computer, 2013:
1) Labour Force Survey 2013. 2) Cambodia Inter-censal Population Survey. 3) Refers to PC, laptop or a tablet. 4) Data correspond to dwellings (not households). 5) Ghana Living Standards Survey 2012/2013. The estimate is based on households who own and/or have access to a desktop, laptop or tablet PCs. Sample weights have been applied. 6) Preliminary. 7) Estimated.

Percentage of households with Internet access, 2012:
1) Estimated based on 2011 proportion of households with internet and using estimated annual growth rate of 2.8%. 2) Preliminary. 3) Data correspond to dwellings (not households). 4) Ghana Living Standards Survey 2012/2013. The estimate is based on households who own and/or have access to internet. Sample weights have been applied. Not restricted to access at home. 5) Incl. desktop computer, laptop / notebook / netbook / tablet, but excluded palm top / Personal Digital Assistant (PDA) and other devices for Internet connection (e.g. smartphone, game console and e-book reader). 6) Accessing from personal computers. 7) Estimate based on 2011 Census Population Household Projection Estimates. 8) From Household Socio-Economic survey-2012. 9) Break in comparability: Refers to access at home, on cell phone or other mobile device and via mobile modem. 10) Census data. 11) Excl. households which didn't know type of internet access 172 346 households. 12) U.S. Census Bureau, table 3 :http://www.census.gov/hhes/computer/publications/2012.htm].

Percentage of households with Internet access, 2013:
1) Labour Force Survey 2013. 2) Corresponds to all type of internet connections. 3) Data correspond to dwellings (not households). 4) Ghana Living Standards Survey 2012/2013. The estimate is based on households who own and/or have access to internet. Sample weights have been applied. Not restricted to access at home. 5) Included desktop computer, laptop / notebook / netbook / tablet, but excluded palm top / Personal Digital Assistant (PDA) and other devices for Internet connection (e.g. smartphone, game console and e-book reader).

Use indicators

Percentage of individuals using the Internet, 2012:
1) 15 years and older. Last 12 months. 2) Users in the last 3 months. 3) Estimated based on 2011 Residential consumer survey result and TRA analysis of the growth. 4) Individuals aged 16 and over. 5) Preliminary. 6) In the last 3 months. Population 10+. 7) Residents of Canada 16 years of age or older excluding: Residents of the Yukon, Northwest Territories and Nunavut, Inmates of Institutions, Persons living on Indian Reserves, and Full time members of the Canadian Forces. 8) Estimated based on surveys' results. Population age 5+. 9) In the last 3 months. Population 5+. 10) 12+ years. 11) Population 5+.Direct response from individuals 15 years and above. 12) The methodology depends basically on the number of internet users using hard indicators instead of data survey. 13) Ghana Living Standards Survey 2012/2013. The estimate is based on weighting households who use internet by the household size over the total estimated population. Sample weights have also been applied. The question was asked at household level. 14) All persons aged 10 and over. 15) Age 20+. In the last 3 months. 16) Individuals 14 years or older. 17) Break in comparability: population aged 15-74. 18) Individuals aged 3 and over. 19) Refers to total population. 20) Individuals aged 5 years and above. 21) Population 6 years and above. 22) From Household Socio-Economic survey. 23) Last 6 months. 24) Residents aged 7 years and above. 25) Last 6 months; individuals aged 14 and above: target population 6 282 000. 26) Individuals with age between 16 and 74 (According to the Eurostat recommendation). 27) Reference period for computer and Internet usage is 3 months only. 28) U.S. Census Bureau, Table 2 : http://www.census.gov/hhes/computer/publications/2012.htm].

Percentage of individuals using the Internet, 2013:
1) Individuals aged 15 years and over. 2) Population age 16-74. 3) Labour Force Survey 2013. 4) Individuals aged 6 and over. 5) Cambodia Inter-censal Population Survey 2013. 6) Permanent residents at the age of 6 or above. In the last 6 months. 7) population 5+. 8) Total population. In the last three months. 9) 12+ years. 10) Population 5+.Direct response from individuals 15 years and above. 11) In the last 12 months. Individuals aged 10 and above. 12) Ghana Living Standards Survey 2012/2013. The estimate is based on weighting households who use internet by the household size over the total estimated population.

Sample weights have also been applied. The question was asked at household level. 13) All persons aged 10 and over. 14) Age 20+. In the last 3 months. 15) Individuals age 3 and above. 16) Refers to total population. 17) Individuals 5+. Excluding population living in workers' camps. 18) Population age 10+ using internet in the last 3 months. 19) Individuals aged 15 to 72 years. 20) Estimated. Residents aged 7 years and above. 21) Last 6 months; individuals aged 14 and above: target population 6 370 000.

Fixed (wired)-broadband subscriptions per 100 inhabitants, 2012:

1) Internet Activity Survey, June. 2) Incl. fixed wireless broadband. 3) Fixed broadband in Bhutan is provided via ADSL/DSL networks only. 4) As of 2012 it includes also FTTH. 5) Expert assessment, based on the data provided by 89.1% of operators. 6) The figure is corrected. The previous figure was 1'636'700. 7) Only ADSL, excl. cable modem. 8) Speeds greater than, or equal to, 512 Kbps. 9) By December 2012. 10) Only ETL and LTC. 11) Preliminary. 12) Full VDSL. 13) Speeds equal to or greater than 144 kbit/s. 14) Operators data/ictQATAR estimate. 15) Incl. subscriptions at downstream speeds equal to, or greater than, 144 kbit/s (the number of subscriptions that are included in the 144-256 range is insignificant). 16) Q3. 17) Excl. 3203 WiMAX subscriptions. 18) Excl. corporate connections. 19) Data reflect subscriptions with associated transfer rates exceeding 200 kbps in at least one direction, consistent with the reporting threshold the FCC adopted in 2000. 20) Incl. ADSL and FTTH.

Fixed (wired)-broadband subscriptions per 100 inhabitants, 2013:

1) November 2013. 2) Preliminary. 3) Internet Activity Survey, June 2013. 4) Fixed broadband provided through ADSL/DSL and Fiber links. 5) Estimate, no specific data collected for ≥ 256 kbit/s. 6) CRC estimation as of 31.12.2013. 7) Estimate. 8) Data based on NRA estimates. 9) Only ADSL, excl. cable modem. 10) Speeds greater than, or equal to, 512 Kbps. 11) December 2013. These are the subscriptions with the minimum download speed of 512 kbps. This is as per the revised definition of Broadband in India with effect from 18th July 2013. 12) December. 13) ADSL and Leased lines. 14) Based on 2013Q3 data. 15) Per June 2013. 16) Operators' data. 17) Incl. subscriptions at downstream speeds equal to, or greater than, 144 kbit/s (the number of subscriptions that are included in the 144-256 range is insignificant). 18) Q4 report. Definitive data (annual report) may change because quarterly reports use a smaller sample of operators than annual report. 19) Estimate. Refers to March 2013. 20) Excl. 3175 WiMAX subscriptions. 21) Excl. corporate connections. 22) 2013 data is an estimate as of June 30, 2013. Data reflect subscriptions with associated transfer rates exceeding 200 kbps in at least one direction, consistent with the reporting threshold the FCC adopted in 2000 .

Wireless-broadband subscriptions per 100 inhabitants, 2012:

1) Only fixed WiMAX subscriptions. 2) Internet Activity Survey, June. 3) Break in comparability: including all categories of mobile broadband. 4) Total number of EDGE/GPRS subscribers: 97 520. 5) Break in comparability: from this year incl. USB modems and dongles, mobile broadband (>256kbps at least in one direction up to HSPA+), WiMAX, Pre WiMAX, SID and satellite. 6) Change in definition, break in comparability. 7) High use of mobile phones to access the internet. 8) Incl. Home Box and RLANs. 9) Break in comparability, from this year incl. prepaid mobile-broadband subscriptions. 10) Incl. subscriptions to WiFi hotspots. 11) Methodology changed from ability to have mobile broadband to actual mobile broadband usage. 12) Satellite, BWA and active mobile subscriptions. 13) Estimate based on partial SIT data and ITU estimates. 14) Speeds greater than, or equal to, 512 Kbps. 15) Rightel (Tamin Telecom) has been given license to operate 3G services and started services from February 2011 (http://www.rightel.ir/). Data refer to the sum of fixed wireless broadband and active mobile-broadband subscriptions. 16) Incl. mobile broadband and WiMAX. 17) Estimate. 18) ETL and LTC. 19) Incl. narrowband connections. 20) Drop in mobile-broadband subscriptions because in 2011 the operator offered free Internet access for a limited amount of time so that many people used the free service. 21) Preliminary. 22) Mobile broadband only. Fixed wireless and satellite exist but data are not available. 23) Operators data/ictQATAR estimate. 24) Refers to active mobile-broadband subscriptions only. 25) Dec. 26) Incl. 4125165 active mobile-broadband subscriptions plus 3203 WiMAX subscriptions. Excl. satellite subscriptions. 27) Excl. satellite and fixed wireless. 28) Incl. mobile subscriptions with potential access.

Wireless-broadband subscriptions per 100 inhabitants, 2013:

1) Only fixed WiMAX subscriptions. 2) Preliminary. 3) Internet Activity Survey, June 2013. 4) Total number of EDGE/GPRS subscribers is 112 898. 5) Incl. LTE subscriptions from ENTEL. 6) Change in definition, break in comparability. 7) 2012 figures. Still auditing the 2013 figures. 8) Incl. WCDMA, LTE, dedicated mobile-broadband and fixed wireless. 9) CRC estimation as of 31.12.2013 .speeds equal to or greater than 144 kbit/s/. 10) Estimate. 11) Estimate .Incl. subscriptions to WiFi hotspots. 12) Satellite, BWA and active mobile subscriptions. 13) Incl. VSAT. 14) Speeds greater than, or equal to, 512 Kbps. 15) subscriptions with minimum download speed of 512 kbps. This is as per the revised definition of Broadband in India with effect from 18th July 2013. 16) Data refer to the sum of fixed wireless broadband and active mobile-broadband subscriptions. 17) 2013 data is an estimate as of June 30, 2013. 18) Incl. mobile broadband and WiMAX. 19) Estimate based on 1. Standard mobile subscriptions using data services 2. Dedicated data subscriptions 3. Add on data packages. 20) Based on 2013Q3 data. 21) Per June 2013. 22) Mobile broadband only. Fixed wireless and satellite exist but data are not available. 23) Operators' data. 24) As at Dec 2013. 25) Q4 report. Definitive data (annual report) may change because quarterly reports use a smaller sample of operators than annual report. 26) Wireless Broadband services are not being offered in St. Vincent as yet. We anticipate that Mobile broadband and terrestrial fixed broadband services would be in place by the end of 2014. 27) OFCOM estimate. 28) Includes: active mobile-broadband subscriptions plus 3175 WiMAX.

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